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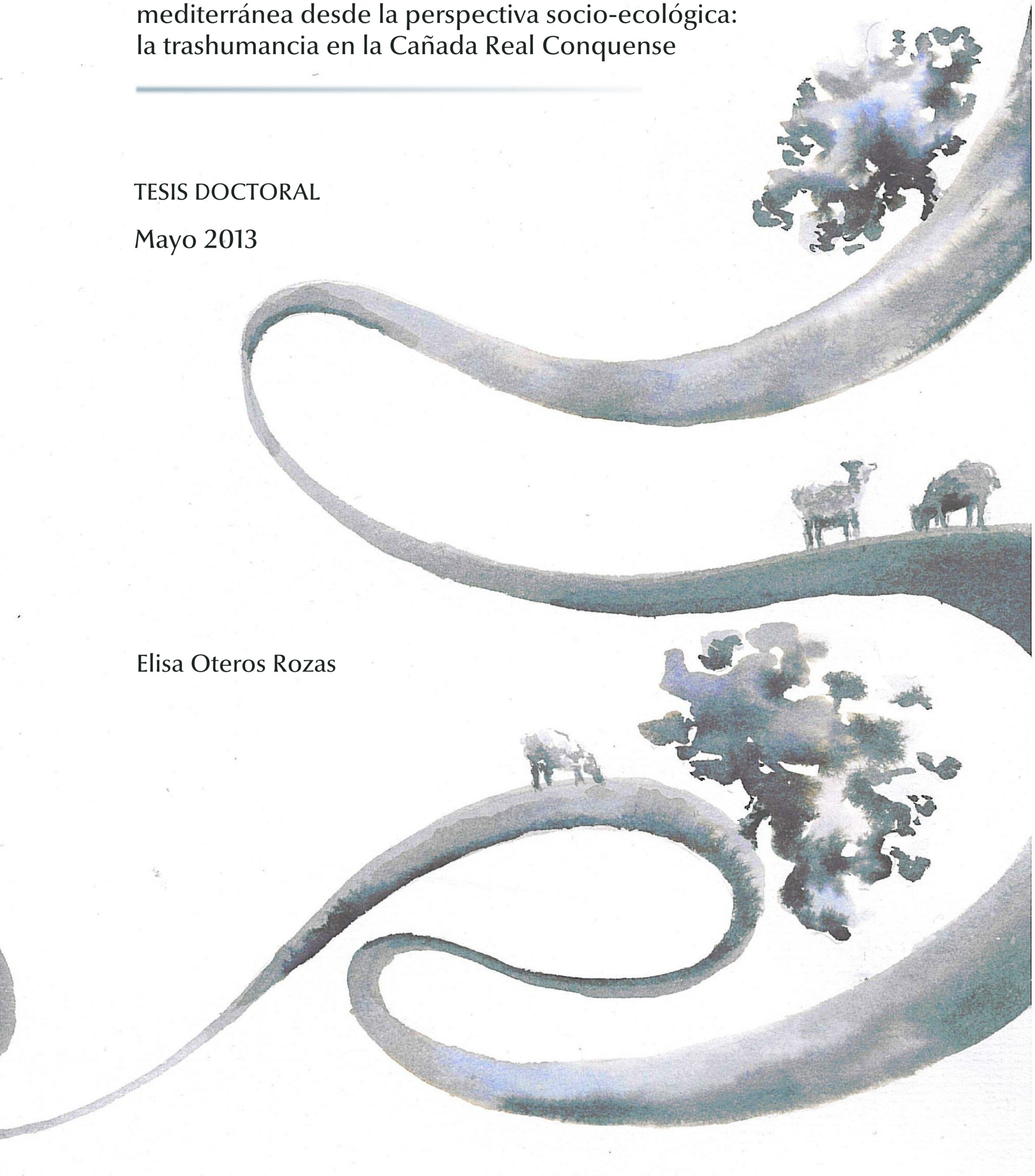
Análisis de una práctica agraria tradicional en la cuenca mediterránea desde la perspectiva socio-ecológica: la trashumancia en la Cañada Real Conquense

TESIS DOCTORAL

Mayo 2013



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Análisis de una práctica agraria tradicional en la cuenca mediterránea desde la perspectiva socio-ecológica: la trashumancia en la Cañada Real Conquense

Memoria presentada por Elisa Oteros Rozas para optar al Grado de Doctora

en Ecología por la Universidad Autónoma de Madrid

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La presente tesis doctoral ha sido realizada en el Laboratorio de Socio-Ecosistemas del Departamento de Ecología de la Universidad Autónoma de Madrid, con estancias en el Ecosystem Services Research Group de la Academia de Ciencias y Humanidades de Berlín-Brandenburgo (Alemania) y en el Grupo de Investigación Social y Acción Participativa (GISAP) de la Universidad Pablo de Olavide de Sevilla.

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A Julita, a mi madre y a mi padre, a Luis.

A los y las trashumantes.

"Times change. Would you call this age a good one for unicorns?"
No, but I wonder if any man before us ever thought his age a good one for unicorns."

P.S. Beagle: **The last unicorn**.

"El genio de España no podrá ser comprendido sin la consideración de este ir y venir de los rebaños por montañas y llanuras... Los ganados trashumantes son centenares y centenares. Cruzan y recruzan toda España. Levantan en las llanuras polvaredas que se diría movidas por un ejército".

Azorín: **Una hora de España**. Madrid, 1924.

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El camino de una tesis doctoral tiene cierto parecido con una vereda: una se alegra sobre todo cuando empieza y cuando acaba. Al comienzo la alegría, los nervios del viaje y la incertidumbre de lo que está por venir, se entremezclan con la nostalgia de lo que se deja atrás. Al final, en cambio, se echa la vista atrás y parece que ha pasado una vida entera de tantas anécdotas, y entre la alegría se atisba también cierto sabor a nostalgia por el cierre de una etapa. Entre medias quedan cientos de historias, aventuras y sobre todo, de compañeros y compañeras de viaje.

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EXECUTIVE SUMMARY

Introduction and objectives

The impact of human actions on fundamental global processes regulating the functioning of the Earth system (usually known as "global change"), poses many important challenges to society and to academia. Sustainability Science emerges as an approach seeking to address these challenges from new approaches based on complex systems theory and by applying an interdisciplinary, participatory and socio-politically transformative perspective. Because interactions and synergic relationships have to be explored in order to face the present and future in a more sustainable way, a dialogue and reflection arena where epistemological frameworks, theories, disciplines, perspectives and different stakeholders can interact and build new paradigms is needed. Ecology stands as this possible arena, taking into account its capacity to disaggregate in order to hybridise with other disciplines.

Within Sustainability Science, the concept of "social-ecological systems" arises as a bridge-object for the study of human-nature relationships, including the direct and indirect drivers of change influencing the functioning of ecosystems. As they are complex adaptive systems, social-ecological systems are characterised by aggregation, non-linear behaviors, diversity, flows and feedback mechanisms. The sustainability of social-ecological systems strongly depends on their resilience, i.e. their capacity to assume different levels of uncertainty and withstand disturbance without losing their capacity for self-organization and the regulating mechanisms that determine their structure and functioning. Hence, resilient social-ecological systems can withstand disturbance, adapt and re-organise without losing their capacity for the provision of multiple ecosystem services, which are understood as the direct and indirect contributions of ecosystems to human well-being. Recently, evaluations of ecosystem services have increased in the scientific literature, particularly after the Millennium Ecosystem Assessment. However, the frequent focus on the monetary dimension of value is (1) concealing the biophysical and socio-cultural dimensions, and (2) overweighting provisioning services, mostly with market value, in comparison to regulating and cultural services. Consequently, there is a need to elucidate trade-offs and synergies between ecosystem services, as well as ecosystem services bundles, in order to deal with complexity. Moreover, understanding the socio-cultural dimension of ecosystem services through the consideration of multiple stakeholders stands as one of the key challenges.

Agroecosystems cover 38% of Earth's terrestrial surface, of which 75% is directly (pasture and grazing lands) or indirectly (croplands devoted to animal feed) dedicated to livestock rearing. Approximately 2,500 million people in the world depend on farming activities (200 million on pastoralism). However, agroecosystems are important not only for provisioning services, but also for regulating services such as pollination, and cultural services such as traditional ecological knowledge or recreational uses. Pastoralism has been recognised as a key tool for sustainability, particularly in mountains and rural areas. In the Mediterranean Basin, agroecosystems are the result of a millenary co-evolution between human populations and ecosystems, and their multifunctionality and key role in biodiversity conservation has been internationally recognised, particularly in relation to traditional farming practices. In the last decades, however, farming practices and ecosystems (particularly pastoralism and grasslands) within this region are suffering from different drivers of change that have fostered rural exodus and hence (1) land abandonment in some areas, and (2) agricultural intensification in others. In Spain, these two processes have taken place later than in other European areas, therefore allowing on the one hand the persistence of some traditional farming practices that comprise High Nature Value Farming Areas, and on the other hand have negatively affected the provision of ecosystem services.

Among traditional farming practices, nomadic pastoralism constitutes an adaptation typical of semi-arid regions, deserts and upland areas (so called "marginal areas") where natural resources availability may be highly variable, both spatially and temporally, respect to temperature and rainfall, equating to high variability in plant productivity.

Transhumance is a form of nomadic pastoralism that appears where climatic contrasts are large but predictable, so that the migration fluctuates between two extremes, in latitude and/or altitude. Wintering areas are usually located at more temperate latitudes and/or lower areas, while summering areas are found in more mountainous (and northern in the case of the northern hemisphere) areas. The two journeys tend to take place when the productivity peak is occurring in-between these two areas, therefore taking advantage also of their primary productivity peaks. Transhumance has been widely recognised as an important traditional farming practice for provisioning services such as high-quality meat and wool, regulating services, such as seed dispersal, and cultural services, such as cultural identity and traditional ecological knowledge, while contributing to biodiversity conservation. For this reason, drove roads in Spain (extending over about

125.000 km and 400.000 ha) were granted legal protection in 1995 with the Drove Roads Act. The main drivers affecting nomadic pastoralism in general are integration within the market economy, sedentarization policies, land grabbing and common-land privatization and institutional limitations hindering mobility.

The study of transhumance in Spain has been largely undertaken from the perspective of Anthropology, History, Economy and Ecology, but frequently through uni-disciplinary approaches. In this context, the general aim of this PhD dissertation is *to explore, from the conceptual framework and with the methodological toolboxes of Sustainability Science, the role of traditional farming practices (using transhumance as a case study), in the delivery of ecosystem services, as well as their value for sustainability and resilience of agroecosystems in the Mediterranean Basin.*

Study area and methodological approach

The wide geographical context of the dissertation is the Mediterranean Basin but the case study refers to transhumance in the *Conquense Drove Road*, a major active transhumance network in Spain. In 2009, local agrarian offices granted livestock movement permits in this area to 87 transhumant shepherds, driving almost 60,000 livestock heads, most of whom used trucks but 15 of whom walked the drove with approximately 8,900 sheep and 1,200 cows. The summering area, located in the eastern Montes Universales (northwest of the Iberian Peninsula, Spain) where herds stay from July to early November, is characterised by semi-deciduous vegetation, coniferous forests, and patches of agricultural land where fodder crops are grown. The drove road is a 75-m-wide and approximately 410-km-long corridor that crosses predominantly cultivated areas in the Iberian Central Plateau consisting mostly of vineyards, olive orchards, and fields of sunflowers and cereals. The wintering area, located in Sierra Morena (southeast of the Iberian Peninsula) and the southern fields of La-Mancha where herds stay from December to May, is characterised by a typical Mediterranean dehesa landscape (an agrosilvopastoral ecosystem aimed mainly at extensive livestock grazing).

In order to undertake the proposed objectives, a combined qualitative and quantitative approach has been applied, as required within Sustainability Sciences. Data collection was mainly carried out through methods from the Social Sciences, particularly: (1) literature reviews (about Sustainability Science, ecosystem services, ecosystem services valuation, socio-cultural valuation of ecosystem services, social-ecological resilience and adaptive capacity, Mediterranean-Basin agroecosystems' ecology, pastoralism, nomadism, transhumance and other livestock movements, traditional/local ecological knowledge, participatory scenario planning); (2) field work (between February 2009 and October 2011) during three stages of approximately four-months with pastoralists, one complete transhumance journey (31 days), between one and five field trips (2-7 days) in each of ten transhumance journeys and five sampling campaigns for interviews and surveys. The field work consisted of: (1) participant observation, (2) semi-structured in-depth interviews (*N* =69), (3) questionnaires (*N* = 880), (4) a focus group, and (5) two participatory workshops. Statistical data analysis consisted mainly of median and mean differences tests and multivariate statistical techniques.

Results

The results section comprises a compilation of seven papers (Figure 1). Chapter 1 constitutes an exploratory analysis of ecosystem services valuation studies in the Mediterranean-Basin agroecosystems, through a systematic review of 165 scientific papers. We identified scant use of socio-cultural valuation methods and multi-criteria analysis, a limited presence of studies evaluating bundles of ecosystem services, little participation of stakeholders in research and a sparse scattering of scenario planning approaches.

Chapter 2 to chapter 7 are focussed on the case study of transhumance in the Conquense Drove Road. In chapter 2 the case study is conceptualised as a social-ecological network, i.e. an adaptive network of biophysical and social flows generated and maintained by the movement of shepherds and livestock, and a methodological framework for the evaluation of ecosystem services is developed. The work is structured in four sequential phases: (1) characterisation of the social-ecological network associated with transhumance, (2) preliminary identification and characterisation of ecosystem services, (3) evaluation of ecosystem services (in biophysical, sociocultural and economic terms), and (4) future scenario planning for the analysis of social conflicts related to ecosystem services use and trade-offs as well as the proposal of management strategies. Stakeholder participation and interdisciplinarity are crosscutting issues permeating the entire process.

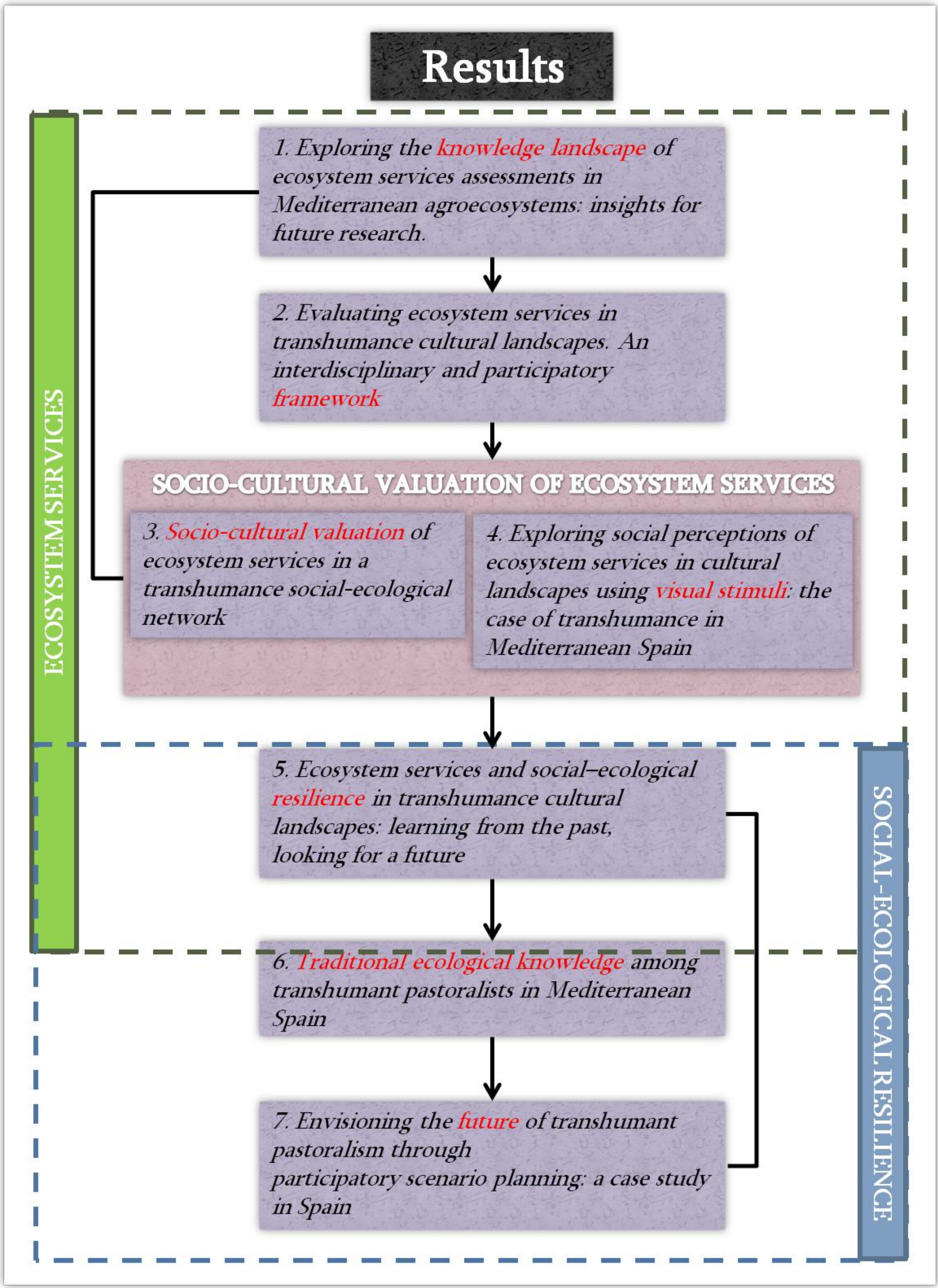

Figure 1. Structure of the dissertation results and objectives.

In Chapters 3 and 4 we carry out two socio-cultural valuations of the ecosystem services provided by the transhumance social-ecological network. Chapter 3 is based on social preferences of 34 ecosystem services (10 provisioning, 12 regulating, and 12 cultural) for social and personal well-being. The ecosystem services considered most important for social well-being were fire prevention, air purification and livestock. Most of the ecosystem services were perceived as undergoing a negative trend, except those associated with recreation, scientific knowledge and environmental education. In chapter 4, we use visual stimuli (though paired photographs) to explore social perception of 16 ecosystem services between landscapes with and without a drove road. All three types of ecosystem services (provisioning, regulating and cultural) were more strongly associated with the landscapes where the drove road was present. In both studies (chapter 3 and 4) factors such as age, place of origin, gender, sense of place, environmental attitude, relationship with transhumance and educational level differentiated respondents' preferences towards ecosystem services.

Chapter 5 acts as a bridge between the two main conceptual frameworks of the dissertation, by using the ecosystem services approach to analyse how transhumant practices contribute to resilience building. We explore these links and address how resilience building works in practice in transhumance landscapes.

As a consequence of the findings in chapters 3 and 5, a detailed study of transhumance-related traditional ecological knowledge was carried out (chapter 6). It was found that, although a rich body of traditional ecological knowledge (TEK) persisted among transhumant shepherds, there was a marked loss of TEK among transhumants born after 1975, who scored one-fifth lower in TEK surveys than other generations. The maintenance of transhumance on foot was the most important factor influencing TEK preservation. We conclude that in developed countries, maintaining conditions for herd mobility can contribute to enhancing the adaptive capacity of agricultural societies to cope with global environmental change.

Finally, chapter 7 presents a participatory scenario planning exercise for transhumance in the Conquense Drove Road. For this, the drivers influencing the past and present situation of transhumance were analysed, four future scenarios for this activity were envisioned, and ecosystem services' trade-offs between different scenarios and their effects on human wellbeing were identified. Finally measures and actions for the maintenance of transhumance are provided. As a result of the participatory process, priority was given to four management strategies such as (1) the implementation of payment schemes for ecosystem services, (2) the enhancement of institutional coordination and social capital among transhumants, (3) the improvement of product marketing, and (4) the restoration and conservation of drove roads. The implications of the current reform of the Common Agricultural Policy of the European Union for the maintenance of transhumance are finally discussed.

Discussion

From the **conceptual and methodological** point of view, the frameworks and toolboxes of Sustainability Science proved to be useful for the achievement of the proposed aims, in particular: (a) the social-ecological systems framework, (b) the ecosystem services concept and (c) social-ecological resilience theory.

a. Even though transhumance had previously been approached as a cultural landscape, the conceptualization of <u>transhumance as a "social-ecological network"</u> helped to highlight the close, dynamic and multidirectional links between a traditional farming practice and the provision of ecosystem services. This perspective helped to promote the social acknowledgement of some already existing human activities, such as traditional farming practices and transhumance in particular, as sustainability examples, particularly in the context of Mediterranean-Basin agroecosystems.

b. The <u>ecosystem services concept</u> allowed to underline the current invisibility of regulating and cultural services of agroecosystems in comparison to provisioning services, and allowed trade-offs, synergies and bundles of ecosystem services to be identified. The approach applied also permitted the possible consequences of different future scenarios, in terms of human well-being to be explored, thus incorporating uncertainty in the assessment. The importance of conflicts and cooperation between beneficiaries of ecosystem services also emerged in the research. In particular, socio-cultural valuation of ecosystem services helped to: (1) incorporate participation and different types of knowledge, (2) identify ecosystem services that do not have a market value, (3) obtain an early warning about possible threats to ecosystem services provision, (4) incorporate non-material links between society/individuals and nature, and (5) explore and unravel differences among stakeholders in the perception of ecosystem services. The participatory and interdisciplinary approaches applied, though presenting several challenges such as the equilibrium and dialogue between Social and Natural Sciences and between scientific/technical and local/traditional knowledge, proved to be a key factor for the achievement of the research goals. Moreover, the combination of qualitative and quantitative research methods showed their methodological complementarity.

c. The resilience theory was applied as a metaphor and hybrid concept in order to learn from the past to allow a better understanding of present and future challenges that transhumance is facing, as well as how uncertainty and direct and indirect drivers might influence the social-ecological network. Transhumance has proven to be, not only an adaptive strategy (based on mobility) itself, but a source of traditional ecological knowledge (including practices) with an outstanding value for adaptation to global change.

Some reflections and insights are also elucidated in relation to **pastoralism and transhumance**. Intensive agriculture and pastoralism attract worldwide attention from two general perspectives: (1) for their environmental assets (ecosystem services) and (2) for their negative impacts on ecosystems (dis-services). On one hand, we identified 34 ecosystem services provided by the ecosystems related to transhumance in the case study and discuss about the potential and interest of the practice as an example of sustainability. On the other hand, we analysed transhumance "under the shadow" of the main criticisms to extensive livestock (eg. impact on climate change) and reveal some land-use conflicts (eg. with conservation or between farmers and pastoralists).

Some key points are discussed particularly within the Spanish context, (a) under the current reform of the Common Agricultural Policy of the European Union (CAP), (b) within the debate about payments for ecosystem services (PES), (c) with regard to the Agroecology and the Food Sovereignty alternative paradigms, (d) in relation to the social-ecological sustainability of transhumance in the 21st century, and (e) in the current national context of potential privatization of common and public resources.

a. Since the late 1980s in the EU, the CAP has been the most important agricultural policy mechanism influencing agricultural landscapes and the largest agriculture support system worldwide. In the case of transhumance in the Conquense Drove Road, a two-fold negative effect of the CAP was highlighted: (1) the enlargement of flocks had hindered mobility, and (2) the rural development strategies included support measures for the settlement of rural populations that have indirectly encouraged sedentarisation. However, the current context of the reform for the period 2014-2020 could provide an opportunity to improve the support for transhumance, and of other traditional farming practices proved to be responsible for ecosystem services delivery.

b. Some agri-environmental measures of the CAP can be interpreted as a form of Payments for Ecosystem Services (PES). However, in the case study a marked difference in the social perception of agri-environmental subsidies and PES was identified: while the first are seen as a necessary support for the economic profitability of the farming activity in the global market (being generally perceived as undesirable), the second are perceived as the fair acknowledgement of society for the ecosystem services the farming practices contribute to provide (therefore perceived as highly desirable). We suggest that some PES might be of interest in the case of pastoralism (and transhumance); however, we provide some insights for several steps that should be taken previous to the implementation of PES schemes, such as: (1) analyzing advantages and disadvantages of payments for single ecosystem services or for the farming practice as a whole, (2) identifying what ecosystem services would better fit for PES schemes related to livestock faming, (3) explore possible interaction of PES with local informal institutions and on land-use change, and (4) explore possibilities for PES design and implementation through co-adaptive management.

c. In opposition to the mainstream policies and perspectives about agroecosystems as food/fuel machines or financial objects, Agroecology (between academia and social movements) and Food Sovereignty (as a political peasant movement) are suggesting alternative ways of considering farming practices. In this regard we suggest that the ecosystem services concept and their valuation, if adequately applied, can help unravel the other (non-provisioning) services and values of small, peasant, traditional farming practices.

d. In relation to the social-ecological sustainability of transhumance in the 21st century six key characteristics are identified: (1) adaptation and coupling to the supporting ecosystems, (2) adaptability in the face of social-ecological changes, (3) conservation of supporting ecosystems, (4) limited demand of inputs, (5) decentralised production of food, (6) conservation of social-ecological memory. However, a number of economical, political/legislative and socio-cultural drivers of change that are currently threatening pastoralism and transhumance have been identified and measures and actions are given to face these challenges.

e. As urban population enlarges, public policies tend to increasingly reflect and react to urban perceptions, needs and demands, in opposition to rural ones (the rural-urban divide), therefore favoring some bundles of ecosystem services against others. In this regard, we propose that: (1) traditional agrarian practices should gain more attention from the policy arena as an intermediate, low impact, scarcely-input-demanding disturbances between land-use intensification and land-abandonment (the two current most typical trends in Mediterranean agroecosystems); and (2) common and public resources and rights, as well as autonomy of local institutions, must be maintained without privatization. The loss of common and public assets, such as forests, grasslands and drove roads, would arguably further complicate the maintenance of traditional agrarian practices and, in particular, pastoralism and transhumance that strongly rely on them.

Concluding remarks

Although agroecosystems, and particularly those associated with traditional farming practices, are the result of a historical co-evolution between social and ecological systems, few studies have approached them from a multidimensional perspective within the framework of social-ecological systems, ecosystem services, and resilience. The conceptualization of a specific traditional management practice, such as transhumance, as a social-ecological network has allowed us to identify and analyse the socio-cultural dimension of ecosystem services as well as the underlying drivers of change affecting the agroecosystems' capacity to provide them. Building upon both technical/scientific knowledge and local/traditional knowledge, this participatory and interdisciplinary approach has provided useful information to inform the policy decision-making process regarding traditional management practices in Mediterranean agroecosystems.

RESUMEN

Los agroecosistemas ocupan más de un tercio de la superficie terrestre del planeta, con tres cuartas partes de esta superficie vinculadas directa o indirectamente con la ganadería. Estos sistemas han sido reconocidos internacionalmente no sólo por su importancia económica y para la alimentación de las poblaciones humanas, sino como suministradores de servicios de regulación como el almacenamiento de carbono en pastizales, o culturales como los usos recreativos y por su relevancia en la conservación de la biodiversidad. En el contexto de la cuenca mediterránea, en concreto, los agroecosistemas son el resultado de una co-evolución milenaria entre las poblaciones humanas y la naturaleza, donde las prácticas agrarias tradicionales juegan un papel fundamental para su sostenibilidad.

Una de estas prácticas tradicionales, con gran arraigo en España, es la trashumancia, una forma de pastoralismo nómada especialmente útil en zonas marginales y de clima fluctuante, que consiste en el desplazamiento estacional del ganado entre zonas altas o de mayor latitud, destinadas a pastos de verano, y zonas bajas o de menor latitud, en las que el ganado pasa el invierno, siguiendo rutas regulares establecidas. La trashumancia se ha practicado históricamente en toda la cuenca mediterránea, donde resulta altamente adaptativa, ya que permite acoplar los ciclos estacionales de movimiento del ganado a los picos de productividad de pastos. A pesar de ello, la práctica de la trashumancia viene sufriendo un largo proceso de abandono a pesar de su reconocido valor ecológico y socio-cultural.

En este contexto, el objetivo general de esta Tesis Doctoral es explorar, desde el marco conceptual integrador y las herramientas propias de las Ciencias de la Sostenibilidad, el papel de las prácticas agrarias tradicionales en la generación de servicios de los ecosistemas y sus implicaciones para la sostenibilidad y resiliencia de los agroecosistemas de la cuenca mediterránea, usando para ello como caso de estudio la Cañada Real Conquense, una de las pocas vías pecuarias que mantienen un uso ganadero activo en todo su recorrido.

La trashumancia en la Cañada Real Conquense se ha conceptualizado como una red socio-ecológica (es decir una red de flujos biofísicos y sociales generados y mantenidos por el movimiento de los pastores y su ganado) y se ha desarrollado una propuesta metodológica para la evaluación de los servicios de los ecosistemas mantenidos por la trashumancia, en la cual la participación y la interdisciplinariedad constituyen elementos

transversales. Esta propuesta interdisciplinar y participativa cobra especial relevancia en un contexto donde la evaluación de los servicios de los agroecosistemas en la cuenca mediterránea se encuentra principalmente focalizada en el valor monetario (en detrimento de las dimensiones biofísica y socio-cultural del valor) de los servicios de abastecimiento, desvalorizando los servicios de regulación y culturales, así como obviando las técnicas participativas.

Mediante una combinación de técnicas cualitativas y cuantitativas se valoraron socio-culturalmente los servicios de los ecosistemas asociados con la práctica trashumante en la Cañada Real Conquense, poniéndose de manifiesto que aquellos servicios más importantes para el bienestar humano son los que a su vez son percibidos como en un mayor proceso de deterioro. Por otro lado, a partir de la percepción social de servicios asociada a los paisajes culturales de la trashumancia usando estímulos visuales (pares de fotos) se encontró que el suministro de las tres categorías de servicios se encuentra fuertemente asociado con aquellos paisajes con presencia de una vía pecuaria y de ganado.

Se analiza también la contribución de la trashumancia a la generación de resiliencia socio-ecológica, así como el papel del conocimiento ecológico tradicional en la sostenibilidad de esta práctica. Si bien persiste buena parte de este conocimiento en la zona estudio, se registró una pérdida importante del mismo en la generación más joven. El mantenimiento de la trashumancia a pie es el factor más importante que influye en la preservación del conocimiento ecológico local.

Finalmente, la investigación desarrolló un ejercicio de diseño participativo de escenarios de futuro, que permitió identificar los principales impulsores de cambio que subyacen a la actual situación de la trashumancia, analizar sus efectos sobre los servicios de los ecosistemas y construir propuestas de futuro en aras de mejorar la sostenibilidad socio-cultural, económica y ecológica de la ganadería trashumante. Cuatro grandes propuestas emergen como prioritarias: (1) la implementación de esquemas de pagos por servicios de los ecosistemas, (2) el fortalecimiento de la coordinación institucional y el capital social entre los pastores trashumantes, (3) la mejora de los mecanismos de comercialización y (4) la restauración y conservación de las vías pecuarias. En los países desarrollados, el mantenimiento de las condiciones necesarias para la movilidad de los rebaños puede contribuir a fortalecer la capacidad adaptativa de las sociedades agrarias para lidiar con el cambio ambiental global.

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Capítulo 1 Introducción

1.1. Marco conceptual y epistemológico de la tesis

1.1.1. Las Ciencias de la Sostenibilidad

En el actual contexto global de cambio se hace cada vez más evidente el peso de una "crisis de civilización" (Fernández Buey, 2009; van der Leeuw, 2012) dado que su multidimensionalidad abarca desde la economía y las finanzas, hasta los cuidados, pasando por las crisis de valores, de ética, de racionalidad y la crisis ambiental. El segundo de los informes del Club de Roma, titulado "La humanidad en la encrucijada" (Mesarovic y Pestel, 1975), ya hacía referencia a la noción de crisis global y en él se describía ésta como la acumulación, superposición e interacción de multitud de desequilibrios y perturbaciones, entre los cuales destacan la crisis demográfica o poblacional, la crisis de alimentos, la crisis energética y la crisis medioambiental (Fernández Buey, 2009). Una de las principales diferencias de esta crisis de la que hablamos respecto de otras crisis históricas precedentes es que las múltiples dimensiones que la componen están interrelacionadas e interactúan. La idea clave que surge en torno a esta noción de crisis es la de "insostenibilidad". Múltiples foros internacionales[1] y voces desde la academia advierten, además, de la posibilidad de un colapso civilizatorio (ej. Ehrlich y Ehrlich, 2013).

En este contexto, los retos a los que nos enfrentamos como sociedad y como científicos han sobrepasado los marcos conceptuales previamente aceptados (Jasanoff et al., 1997). En el proceso de toma de conciencia de esta crisis se sacuden por tanto los cimientos mismos de la forma de conocer el mundo y construir conocimientos, hasta llegar a cuestionar el conocimiento científico moderno (Toledo, 2000).

Existe en gran medida, aún hoy, cierta fe en que nuestro creciente conocimiento científico sobre los ecosistemas, nuestras cada vez más sofisticadas herramientas y tecnologías, así como la aplicación de mecanismos de mercado, irán, paulatinamente, contribuyendo a la resolución de los problemas que componen la crisis, como la contaminación o el cambio climático (Berkes et al., 2003). Sin embargo, la experiencia de las últimas décadas no alienta ese optimismo, sino más bien apela a la creatividad en las formas, espacios, lenguajes y formas de colaboración entre los científicos y entre estos y el

[1] Por ejemplo el foro científico Planet Under Pressure (http://www.planetunderpressure2012.net/) o la reciente Cumbre de Desarrollo Sostenible de Río+20 (http://www.uncsd2012.org/).

resto de la sociedad (Berkes et al., 2003) en la búsqueda de soluciones. Este proceso es el que ha dado lugar a una **"revolución conceptual"** (Naredo, 1992) que se manifiesta en el surgimiento de corrientes epistemológicas como "el pensamiento complejo" (Morin, 1990), "los sistemas complejos" (Levin, 1999), "la ciencia pos-normal" (Funtowicz y Ravetz, 1993), "la teoría de los sistemas socio-ecológicos" (Berkes y Folke, 1998), o la "resiliencia socio-ecológica" (Berkes y Folke, 1998; Gunderson y Holling, 2001). A este surgimiento acompaña el nacimiento de una serie de disciplinas híbridas entre las Ciencias Biogeofísicas y las Ciencias Sociales, que se manifiestan como alternativas frente a las barreras de la "pureza disciplinaria" en ocho áreas de conocimiento (Toledo, 2000) a las que cabría añadir la Psicología (Fig. 1.1).

Figura 1.1. Esquema de las áreas de conocimiento (en los óvalos verde claro) y disciplinas emergentes híbridas entre la Ecología y estas áreas de conocimiento que abrazan las Ciencias de la Sostenibilidad. Las disciplinas marcadas en azul son aquellas de las que bebe en mayor medida la presente Tesis Doctoral (basada en Toledo, 2000).

De este **maridaje entre las Ciencias Biogeofísicas y las Ciencias Sociales** con el objetivo común de construir conocimiento con el que comprender y gestionar la actual crisis, surgen las ***Ciencias de la Sostenibilidad***. En 1987, en el conocido como "Informe Brundtland" ("Nuestro futuro común") publicado por las Naciones Unidas, se lanzaba el concepto de Desarrollo Sostenible definido como *"el desarrollo que satisface las necesidades del presente sin comprometer la capacidad de las futuras generaciones para satisfacer las suyas"*. Este hito sirvió de pistoletazo de salida para los debates y los Convenios nacidos de la Cumbre de la Tierra de Río de Janeiro en 1992 que dieron más tarde lugar a las "Ciencias de la Sostenibilidad" para definir el cuerpo científico de conocimiento relativo al Desarrollo Sostenible. En la Cumbre Mundial de Johannesburgo de Desarrollo Sostenible de 2002 (Río+10) se consolidó como conjunto de ciencias emergentes de **vocación interdisciplinaria,** cuyo propósito es la exploración de las interacciones complejas que se establecen entre los sistemas naturales y humanos (Kates et al., 2001; Montes, 2007; Bettencourt y Kaur, 2011; Lang et al. 2012). Nos recuerdan que la naturaleza no puede ser estudiada sin la sociedad, y lo social no puede ser explorado fuera de su contexto ecológico (Toledo, 2000).

El sistema complejo en que existimos y nos desarrollamos debe ser, por tanto, estudiado y comprendido desde abordajes interdisciplinarios que, más allá de las fronteras académicas o los paradigmas, sean capaces de generar espacios de diálogo y conocimiento complejo donde las interacciones entre epistemologías y cosmovisiones sean el **caldo de cultivo de soluciones y propuestas emergentes**. Como reza la famosa frase de Albert Einstein "*los problemas no pueden ser solucionados con la misma racionalidad con que se crearon*".

Desde la última década del siglo XX, aumenta rápidamente el número de estudios en Ciencias de la Sostenibilidad con el objetivo de explorar cómo la ciencia y la tecnología pueden contribuir a conciliar los objetivos de desarrollo humano con los límites ecológicos del planeta. El principal obstáculo para las Ciencias de la Sostenibilidad es, sin embargo, precisamente su obligación de universalidad (Kates et al., 2001; Clark y Dickson, 2003; Parris y Kates, 2003). Entre sus principales retos está el de ser el único campo de conocimiento en la historia de la ciencia que, desde su nacimiento, abarca dimensiones tan diversas y se pone objetivos a la vez tan ambiciosos y urgentes de rigor científico interdisciplinario e impacto tangible socio-ecológico (Bettencourt y Kaur, 2011; van der Leeuw et al., 2012).

Las Ciencias de la Sostenibilidad, de hecho, no surgen de la simple suma de los enfoques ya existentes, sino de la convivencia, la interacción y la capacidad de escucha mutua entre personas, grupos, visiones y disciplinas capaces de generar diagnósticos integrados (Benessia et al., 2012). Es por esto y porque de entre todas las dimensiones de la crisis, la ambiental es la manifestación más sistémica, que **la Ecología se propone como arena de debate y reflexión que se extiende y flexibiliza para abrazar nuevos paradigmas y se "des-integra" para hibridarse con otras disciplinas.**

En ese proceso, numerosos investigadores (ej., Carpenter y Folke, 2006) apelan a la capacidad de la Ecología y las Ciencias de la Sostenibilidad para formular visiones positivas y plausibles de convivencia de la civilización humana en el planeta y la responsabilidad de asumir ese reto junto a técnicos, usuarios, pobladores, responsables políticos y en general gestores de los ecosistemas. Es decir, la **vocación de transformación social y política** constituye un elemento explícito y central en las Ciencias de la Sostenibilidad (van der Leeuw et al., 2012). Su horizonte de acción no se detiene en la generación de conocimiento científico, sino que asume (en mayor o medida) el **compromiso de proponer y aplicar los conocimientos generados**.

La aproximación de las Ciencias de la Sostenibilidad pivota además sobre el eje fundamental de la **participación** (Clark y Dickson, 2003; Jerneck et al., 2011; Lang et al., 2012; van der Leeuw et al., 2012; Wiek et al., 2012), tanto en la generación de conocimiento y comprensión de los sistemas complejos y sus problemáticas, como en la generación de propuestas y la interacción entre la comunidad científica y el resto de la sociedad. Mediante procesos de coproducción y diálogos de saberes, se diluye así también la frontera entre los académicos y el resto de los actores sociales.

El trabajo llevado a cabo en la presente Tesis Doctoral se enmarca en el descrito ámbito de las Ciencias de la Sostenibilidad, por lo que, se pretende, desde una aproximación integradora, arrojar nuevas luces y propuestas de futuro sobre un objetivo de estudio largamente abordado de forma sectorial por diversas disciplinas a lo largo de la historia como es el de la trashumancia en España.

En los últimos años, varios trabajos han resaltado dos fallos fundamentales relacionados con la mayoría de las políticas de gestión de los ecosistemas (Holling y Meffe, 1996; Carpenter y Gunderson, 2001). El primero, se relaciona con el supuesto de que los seres humanos y la naturaleza constituyen dos entidades diferentes que pueden ser conceptuadas y gestionadas independientemente. Frente a este error, surge la aproximación desde los Socioecosistemas o Sistemas Socio-ecológicos, que se abordará en el próximo apartado. El segundo, está relacionado con la presunción de que las respuestas de la naturaleza al uso humano son lineares, predecibles y controlables. Como alternativa a este paradigma, se desarrolla el marco de la Resiliencia, del que se hará también una breve descripción más adelante.

1.1.2. Los Socioecosistemas o Sistemas Socio-ecológicos

La crisis sistémica y la revolución conceptual anteriormente descrita caminan de la mano en un contexto en que el planeta se está viendo crecientemente dominado por los seres humanos, en concreto, severamente afectado por las actividades humanas a un ritmo sin precedentes (ej. Berkes et al., 2003; Williams et al., 2007) en una nueva era geológica bautizada por algunos como "**Antropoceno**" (Crutzen y Stoermer, 2000; Ellis, 2011). Algunos autores muestran cómo hemos sobrepasado los umbrales de cambio de algunos procesos globales claves como la pérdida de biodiversidad, el cambio climático o el ciclo del nitrógeno (Rockström et al., 2009). El *"impacto de la actividad humana sobre los procesos fundamentales que regulan el funcionamiento del sistema Tierra"* se ha denominado "**cambio global**" (ej. Steffen et al., 2004, 2007; Duarte et al., 2006) y sus repercusiones ecológicas influyen cada vez más sobre el bienestar humano (ej. Vitousek et al., 1997; Díaz et al., 2006). La acción humana se manifiesta con múltiples caras o a través de una serie de "**impulsores de cambio**" (Vitousek, 1997; Sala et al., 2000; Tilman, 2000; Röckstrom et al., 2009; Perrings et al., 2011).

Los impulsores de cambio se han definido como "*cualquier factor natural o causado por el ser humano que directa o indirectamente provoque un cambio en un ecosistema"* (Carpenter et al., 2006)" y se han clasificado en directos e indirectos. Los impulsores **directos** influyen sobre los procesos ecológicos, como los cambios de usos del suelo, el cambio climático, los cambios en los ciclos biogeoquímicos y en el ciclo del agua, la contaminación del agua, el suelo y la atmósfera, la introducción de especies exóticas invasoras y la sobre-explotación de los servicios de los ecosistemas. Los impulsores **indirectos** actúan de forma más difusa y lo hacen sobre los impulsores directos. Estos impulsores indirectos serían, entre otros, las tendencias demográficas, la economía globalizada, los marcos legislativos, los impulsores políticos, la tecnología y los cambios culturales en las creencias, los valores, la identidad, el modelo de consumo o el estilo de vida (MEA, 2003; Nelson, 2005).

Los impulsores de cambio, a diferencia de las perturbaciones naturales, no son puntuales y suelen conllevar efectos crónicos en el tiempo (Melinda et al., 2009). Los impulsores de cambio interaccionan además produciendo efectos no simplemente aditivos, sino sinérgicos y, por tanto, difícilmente predecibles en estudios que no sean multifactoriales (Sala et al., 2000). Asimismo, los efectos de los impulsores de cambio a menudo no se hacen evidentes hasta que los ecosistemas no han superado un umbral que hace que esos cambios sean irrecuperables (MA, 2005). En el caso de los ecosistemas Mediterráneos y españoles, los impulsores más destacados hasta ahora han sido los cambios de usos del suelo, la sobreexplotación, la contaminación y las especies exóticas invasoras (EME, 2011).

Los sistemas ecológicos y sociales no sólo están estrechamente ligados, sino que su delimitación es artificial y arbitraria (Berkes y Folke, 1998). Ambos son **sistemas complejos** (Levin, 1999), lo que hace que la gran mayoría de las problemáticas asociadas a la crisis global se caractericen también por dinámicas e interacciones complejas (Norgaard, 1994; Berkes y Folke, 1998) cuyo estudio supone un reto para las aproximaciones científicas más tradicionales (Berkes et al., 2003).

Los sistemas complejos adaptativos tienen cuatro propiedades fundamentales: (1) agregación, (2) no-linealidad, (3) diversidad y (3) flujos (Holland, 1995). En concreto la no-linealidad supone que los sistemas son dependientes tanto de condiciones históricas como actuales: a medida que evolucionan, cambian sus características y la manera en la que interaccionan con el resto de sistemas. Una consecuencia de esta propiedad es la existencia de múltiples cuencas de atracción o estados estables en los ecosistemas, es decir, su comportamiento depende de los umbrales que los "rodean" (Folke, 2006).

De la necesidad de explorar las interacciones entre sistemas humanos y ecosistemas bajo una perspectiva holística, como sistemas complejos, y ante la imposibilidad de "entender la naturaleza sin la sociedad ni entender la sociedad sin la naturaleza" (Beck, 1992) surge el concepto de **"socioecosistemas"** o **"sistemas socio-ecológicos"** (Berkes y Folke, 1998), que son la unidad de estudio de las Ciencias de la Sostenibilidad. Los sistemas socio-ecológicos se definen como sistemas integrados de humanos en la naturaleza, resultado de un proceso coevolutivo a través del tiempo, en el que sistemas sociales y ecosistemas se han ido adaptando y moldeando, rompiendo así la tradicional dialéctica naturaleza-sociedad (Mascia et al., 2003; Anderies et al., 2004).

Según Liu et al. (2007) otras características fundamentales de los sistemas acoplados de humanos en la naturaleza son: (1) que se dan flujos de retroalimentación entre procesos ecológicos y procesos sociales, (2) que el comportamiento de los sistemas cambia de un estado a otro en el tiempo (umbrales temporales) y en el espacio (umbrales espaciales), (3) que se producen "efectos de legado" ("*legacy effects*") en el comportamiento de los sistemas con repercusiones a escalas temporales muy diversas (desde décadas a siglos), y que (4) la información sobre el comportamiento de un sistema no necesariamente es extrapolable a otro.

El análisis de diez años de publicaciones en el ámbito de los sistemas socio-ecológicos en la revista Ecology and Society (Du Plessis, 2008) muestra que hay cuatro proposiciones a partir de las cuales se formula el concepto de socioecosistema:

- "Proposición 1: Un sistema socio-ecológico es un sistema integrado que se extiende a través de la materia, la vida y los fenómenos humanos sociales y culturales (o mentales).
- Proposición 2: Un sistema socio-ecológico consiste en relaciones entre elementos a distintas escalas y entre sistemas anidados.
- Proposición 3: Los sistemas socio-ecológicos son sistemas complejos y adaptativos, con propiedades emergentes y de auto-organización.
- Proposición 4: Lo que diferencia a los sistemas socio-ecológicos de otros sistemas es la introducción del pensamiento abstracto y la construcción simbólica".

Los sistemas socio-ecológicos, como sistemas complejos, son dinámicos, no-lineares, jerárquicamente estructurados, auto-organizados y adaptativos (Berkes y Folke, 1998; Holling, 1998). Desde la escala global hasta la local, las relaciones entre los ecosistemas y los sistemas sociales es multi-escalar y anidada (García-Llorente, 2011) y a cada una de las escalas existen factores que condicionan las propiedades y el comportamiento de los socioecosistemas (Bailey 1985, 2009; Klijn y Udo de Haes, 1994). Asimismo, mientras que los ecosistemas están anidados y los límites de un ecosistema están comprendidos en otro (Allen y Starr, 1982), los límites están abiertos a transferencias de energía y materiales hacia y desde otros sistemas colindantes (Bailey, 1987, 2009). Del mismo modo, la **delimitación** de los sistemas sociales es contexto - y objeto-dependiente y éstos pueden abordarse como un conjunto de sistemas socio-económicos interconectados a través de interacciones inter-escalares (Adger et al., 2005; Chapin et al., 2006). De manera análoga a la de los ecosistemas, los sistemas sociales están integrados unos dentro de otros (Luhmann, 1982; Byrne, 1998; Janssen et al., 2007), desde la economía globalizada y el capitalismo, hasta en último término la manera en la que las personas interaccionan entre ellas y con la naturaleza a escala local, creando visiones, normas y prácticas (Turner et al., 1995; Brunchkhorst et al., 2006; Ostrom, 2009).

Los sistemas socio-ecológicos han sido conceptualizados desde **tres perspectivas** (Becker, 2012): (1) como "*objetos frontera*" situados en la intersección entre campos y disciplinas de investigación; (2) como "*objetos epistemológicos*" que los humanos pueden y quieren conocer mediante métodos de investigación bien definidos y razonamientos teóricos; y (3) como "*objetos reales*" representados en modelos que se construyen con el fin de abordar problemas y fenómenos desde diversos campos de aplicación. En este sentido, los sistemas socio-ecológicos obedecen al objetivo de cada investigación, por lo que la puesta en práctica del concepto en cada caso de estudio, si bien permite acercamientos desde puntos de vista muy diversos (Ostrom, 2009), es siempre subjetiva, artificial y arbitraria (Berkes et al., 2003).

Como aproximación sistémica, el estudio de los sistemas socio-ecológicos se centra en las estructuras y los procesos. Sin embargo, al provenir de la aproximación de la resiliencia (ver sección 1.1.3.), resulta especialmente interesante estudiar cómo estas estructuras perduran y se reorganizan en respuesta a perturbaciones, cambios graduales o transformaciones intencionadas (Peterson, 2011).

1.1.3. El marco de la resiliencia socio-ecológica

Las Ciencias de la Sostenibilidad y la teoría de los sistemas socio-ecológicos están inextricablemente ligadas a **la teoría de la resiliencia**: la sostenibilidad de los sistemas socio-ecológicos depende de su capacidad de asumir diferentes niveles de incertidumbre y afrontar las perturbaciones sin perder su capacidad de auto-organización y los mecanismos de regulación que determinan su estructura y funcionamiento, es decir, su resiliencia (Folke et al., 2003).

El concepto de resiliencia se desarrolla a la par que los de vulnerabilidad y capacidad adaptativa (Holling, 1973; Adger, 2000; Folke, 2006) y en el ámbito de la Ecología es definida por Holling en los años 70 como "*la capacidad de un sistema de absorber o incluso utilizar en su propio beneficio las perturbaciones y cambios para su supervivencia, sin que por ello ocurra un cambio cualitativo en la estructura del sistema*" (Holling, 1973). El mismo Holling (1973), explica que existen, sin embargo, dos grandes corrientes de pensamiento en el manejo del concepto de resiliencia: la primera se refiere a la "resiliencia ingenieril", que sería la *"capacidad que tiene un ecosistema de volver a su estado original después de una perturbación"* (Folke, 2006; Brand y Jax, 2007); la segunda enfatiza en el cambio y la entiende como *"el grado de perturbación que un sistema puede absorber antes de cambiar a otro régimen estable, el cual está controlado por un conjunto diferente de variables organizadas en una estructura diferente"* (Holling, 1973, 1996). La segunda de estas visiones es la que predomina en el marco del estudio de los sistemas socio-ecológicos.

En este contexto, se enfatiza además en la resiliencia como *"capacidad de un socio-ecosistema de aprovechar las oportunidades que surgen como consecuencia de las crisis provocadas, no sólo por los cambios traumáticos, sino también de las circunstancias favorables que aparecen bajo condiciones "normales", haciendo frente a los cambios e incertidumbres"* (Gunderson y Holling, 2001; Olsson, 2003; Olsson et al., 2004; Folke, 2006; Walker et al., 2006). Debido a que existen múltiples acepciones del concepto de la resiliencia (para una revisión crítica sobre el concepto y los retos a los que se enfrenta ver Brand y Jax, 2007), actualmente se plantea como un "*objeto frontera*", es decir, como un término compartido que se usa para favorecer la comunicación y la coordinación entre disciplinas.

Precisamente por la maleabilidad y la vaguedad del propio término, la resiliencia como objeto frontera constituye, además, un puente entre la ecología y la política (Cash et al., 2003) y entre ciencia y aplicación de la ciencia (Becker, 2012). Es posiblemente por esto que el enfoque de la resiliencia ha ido adquiriendo, además, un creciente protagonismo en la agenda política, apareciendo cada vez con mayor frecuencia como un concepto emergente en documentos de organizaciones políticas de nivel internacional (ej. WRI, 2009; NU, 2012).

1.1.4. El marco de los servicios de los ecosistemas

Los sistemas socio-ecológicos más resilientes son aquellos capaces de absorber impactos mayores sin cambiar de manera fundamental. Cuando una gran transformación es inevitable, un sistema resiliente contiene los componentes necesarios para su renovación y reorganización. En otras palabras, el sistema puede enfrentarse, adaptarse o reorganizarse sin sacrificar el suministro de "**servicios de los ecosistemas**" (Folke et al., 2002; Harrington et al., 2010).

La expresión "servicios de los ecosistemas" tiene su origen a comienzos de los años 70, a raíz de la interlocución entre la Ecología y la Economía; pero la primera formalización científica del término se encuentra en el libro titulado "Los servicios de la naturaleza: la dependencia de la sociedad de los servicios de los ecosistemas" (Daily, 1997). Recientemente los servicios de los ecosistemas han sido redefinidos (de Groot et al., 2010) como *"las contribuciones directas o indirectas de los ecosistemas al bienestar humano".* Este concepto se propone como puente entre los ecosistemas y su biodiversidad y el bienestar humano, con el objeto de visibilizar de forma más pragmática la relación de dependencia del segundo respecto de los primeros. Hasta finales del siglo pasado, las iniciativas de conservación se habían basado casi exclusivamente en los valores intrínsecos o en criterios éticos para justificar la conservación de la biodiversidad (McCauley, 2006).

En cambio, desde sus orígenes, el interés por el análisis y la puesta en valor de los servicios de los ecosistemas no ha hecho más que crecer, facilitando la toma de conciencia social de la estrecha dependencia de nuestro bienestar de los ecosistemas y su biodiversidad, así como la escasa visibilidad de este inexorable vínculo en la toma de decisiones (ej. Helliwell, 1969; Odum y Odum, 1972; Costanza et al., 1997; Daily et al. 1997; Turner et al., 2000; Balmford et al., 2002; MEA, 2003).

Los servicios de los ecosistemas se clasifican en tres[2] categorías (MEA, 2005): abastecimiento, regulación y culturales. Los **servicios de abastecimiento** son los productos obtenidos directamente de los ecosistemas (ej. alimento, agua dulce, madera, celulosa, recursos genéticos). Los **servicios de regulación** son aquellas contribuciones disfrutadas de manera indirecta y obtenidas de los procesos de los ecosistemas (ej. regulación del clima, control de inundaciones, depuración del agua). Los **servicios culturales** son las contribuciones no materiales, intangibles, que las personas obtienen de los ecosistemas a través de experiencias (ej. espirituales, recreación y turismo, estéticos, educativos, sentido de identidad, herencia cultural) (Fig. 1.2).

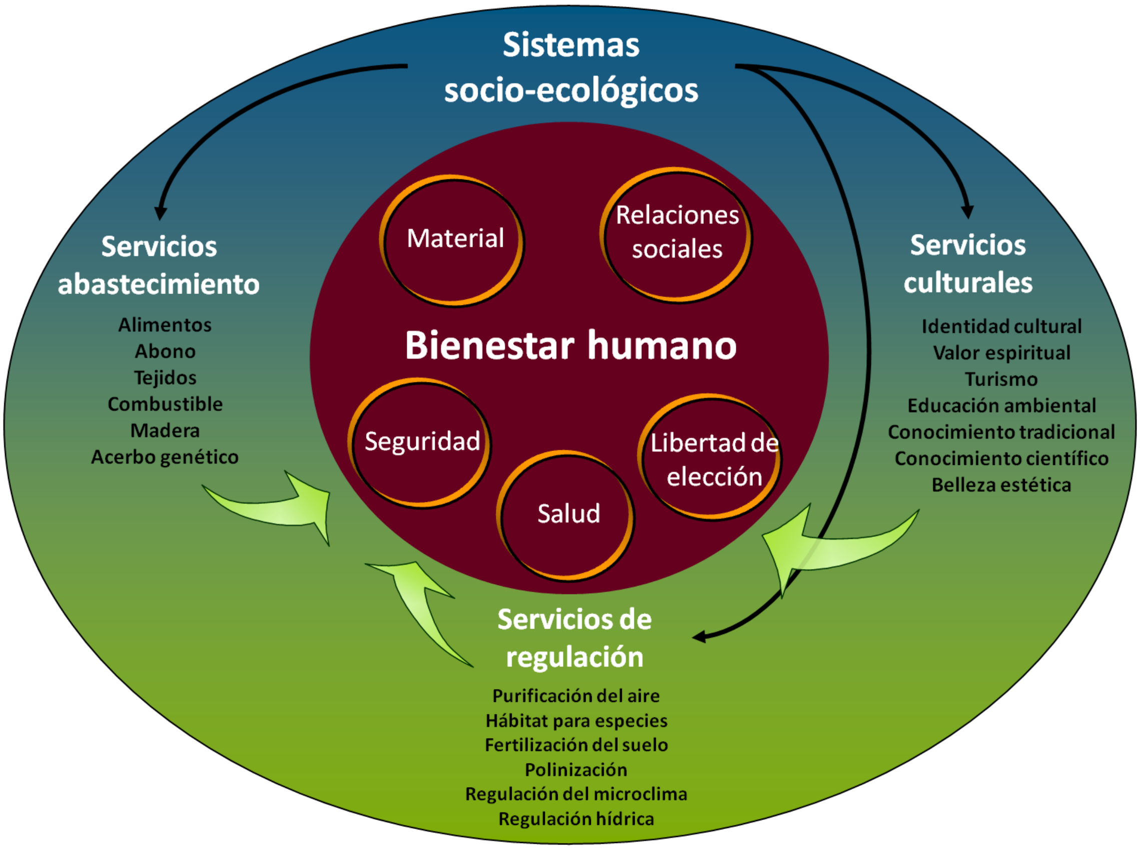

Figura 1.2. Marco de servicios de los ecosistemas (adaptado de EME, 2011).

[2] En la Evaluación de los Ecosistemas del Milenio se hace referencia a cuatro categorías, incluyendo los "servicios de soporte", es decir aquellos procesos necesarios para la producción del resto de servicios (ciclos de nutrientes, productividad primaria, ciclo del agua). La inclusión de la categoría "servicios de soporte" en la valoración ha sido cuestionada porque podría derivar en doble conteo ya que su valor se ve reflejado en los otros tres tipos de servicios (Hein et al., 2006). Por tanto, en esta Tesis se utilizan las categorías de servicios culturales, de abastecimiento y de regulación, sin incluir la de los servicios de soporte.

El mayor empuje para la divulgación del concepto de servicios de los ecosistemas vino de la mano de la mayor eco-auditoría mundial, el Programa Científico Internacional **Evaluación de los Ecosistemas del Milenio** (MEA, por sus siglas en inglés), promovido por Naciones Unidas entre los años 2001-2005 (con la implicación de más de 1300 investigadores de todo el mundo, 40 casos de estudio, el apoyo de cinco Agencias de las Naciones Unidas y cuatro Convenios Internacionales). El resultado principal del proyecto fue el poner de manifiesto frente a gestores, políticos y público en general, cómo la degradación de los ecosistemas y la biodiversidad que albergan afecta directa o indirectamente al bienestar humano, entendiendo éste de manera multidimensional (no sólo en relación a la economía, sino también a la salud, las buenas relaciones sociales, la libertad de elección y acción, los materiales básicos para una vida buena o la seguridad y estabilidad de vida).

De esta forma, se conceptuó el bienestar humano como un subsistema de la esfera biofísica de los ecosistemas, de los cuales depende (Montes y Sala, 2007; EME, 2011). El proyecto incluyó en su análisis diferentes casos de estudio regionales, nacionales y locales, entre los cuales se incluye la reciente **Evaluación de los Ecosistemas del Milenio de España** (EME, 2011). Entre los mensajes clave de la auditoría a escala estatal cabe destacar que el 45% de los servicios de los ecosistemas evaluados se han degradado o se están usando insosteniblemente, siendo los servicios de regulación los más negativamente afectados. Asimismo, se establece que el 63% de los servicios de abastecimiento, el 87% de los servicios de regulación y el 29% de los servicios culturales se encuentran en estado crítico o vulnerable.

A raíz de la MEA se ha producido un aumento exponencial del uso del concepto de servicios de los ecosistemas por parte de académicos, investigadores y tomadores de decisiones (Fisher et al., 2009; Lamarque et al., 2011a; Montes, 2007) para apoyar e informar de la gestión medioambiental y de las estrategias de conservación de la biodiversidad (Chan et al., 2006; Chan et al., 2011). Sin embargo, es importante destacar que, a pesar de la masiva utilización del término "servicios de los ecosistemas", en la mayoría de los foros se da un abordaje desligado del bienestar de los distintos beneficiarios, empleando las palabras y olvidando los conceptos (Lamarque et al., 2011a).

Entre los **principales desafíos** para el estudio de los servicios de los ecosistemas se proponen, entre otros, el mejorar el entendimiento del componente social en el análisis de servicios **involucrando a los distintos actores sociales** (Anton et al., 2010). En este sentido, cobra especial interés la exploración de las percepciones que la sociedad tiene sobre el estado de los servicios de los ecosistemas, el origen de los mismos, las causas de su deterioro, y los efectos sobre el bienestar individual o el de la sociedad en su conjunto, con el fin de entender las prioridades sociales que tienen los diferentes actores (Costanza, 2000). Sin embargo, siguen siendo escasos los estudios que abordan la **dimensión socio-cultural** de los servicios de los ecosistemas (Seppelt et al., 2011; Martín-López et al., 2012).

Asimismo, Seppelt et al. (2011) han planteado recientemente una serie de elementos fundamentales que deben caracterizar las investigaciones en los servicios de los ecosistemas: (1) el trabajo sobre datos reales con respecto a la dimensión biofísica de los mismos, (2) el reconocimiento de posibles efectos a diversas escalas, (3) el involucramiento de los distintos actores sociales en los procesos de evaluación, y (4) la consideración de la posibilidad de que surjan compromisos (***trade-offs***) y relaciones sinérgicas (**sinergias**) que promueven la existencia de conjuntos de servicios relacionados (***bundles***) (Bennett et al. 2009; Raudsepp-Hearne et al. 2010).

En la influyente publicación de Costanza et al. (1997) se planteó la infravaloración de la dimensión ecológica en la toma de decisiones, por el hecho de que los servicios generados por el capital natural no son adecuadamente cuantificados en comparación con aquellos servicios obtenidos del capital producido por los seres humanos. Desde entonces, gran parte de los estudios en el marco de los servicios de los ecosistemas se han centrado en el desarrollo de **métodos que permitan visualizar el papel de los servicios de los ecosistemas**, cuyo valor era sistemáticamente subestimado o ignorado por los mercados y la toma de decisiones (Gómez-Baggethun y de Groot, 2007). En la actualidad, desde las Ciencias de la Sostenibilidad se plantea la naturaleza multidimensional del valor, o la existencia de valores plurales (ecológico, socio-cultural y monetario,) que pueden ser inconmensurables entre sí, es decir, que no necesariamente pueden ser reducidos a una única unidad de medida común (Gómez-Baggethun y de Groot, 2007).

1.2. Los agroecosistemas como sistemas socio-ecológicos

Los agroecosistemas son ecosistemas en los que los seres humanos han seleccionado deliberadamente plantas y animales para reemplazar a la flora y la fauna natural (Altieri y Koohafkan, 2004). En EME (2011) se define como **agroecosistema** *"cualquier tipo de ecosistema modificado y gestionado por los seres humanos con el objetivo de obtener alimentos, fibras u otros materiales de origen biótico"* (Gómez Sal, 2001). La diversidad de agroecosistemas en el mundo en función de la intensidad de la acción humana es muy elevada: desde agroecosistemas extremadamente simplificados (como la agricultura intensiva, la horticultura de invernadero o la ganadería intensiva) hasta los de baja intensidad (como los huertos familiares, la ganadería nómada, las granjas tradicionales o la agricultura con rotaciones), pasando por los de intensidad media de manejo (como los cultivos múltiples o la horticultura mixta) (Altieri y Koohafkan, 2004).

A nivel mundial, los agroecosistemas (incluyendo usos agrícolas y ganaderos) ocupan el 38% de la superficie terrestre libre de hielo, correspondiendo el 12% a cultivos y el 26% a pastizales (Foley et al., 2011). La agricultura y ganadería son por lo tanto el **uso del suelo más extendido** en el planeta. Entre 1985 y 2005 la superficie mundial ocupada por pastos y cultivos aumentó un 3%, especialmente en los trópicos (Foley et al., 2011). Si se suma la superficie dedicada a cultivos para piensos (cerca de 350 millones de hectáreas) a la ocupada por los pastizales (3,38 mil millones de hectáreas), la superficie total dedicada a la ganadería es de 3,73 mil millones de hectáreas, es decir el 75% de la superficie agraria mundial (Foley et al., 2011). En Europa los agroecosistemas ocupan el 45% de la superficie (EASAC, 2009) y, según diversas estimaciones recientes, esta cifra oscila entre un 47% (Beaufoy et al., 2012) y un 60% (EME, 2011) en el territorio español, aunque los datos varían según la amplitud de la definición de agroecosistema que se emplee, especialmente en relación a los pastizales y los ecosistemas con usos silvopastorales como las dehesas (EME, 2011).

Los agroecosistemas tienen un papel fundamental como suministradores de servicios, así como por ser considerados generadores de "deservicios" (servicios no deseados) (Swinton et al., 2007). Los agroecosistemas son los **principales proveedores del servicio de alimentación** en el mundo, por lo que no se puede obviar el crucial papel que juegan frente al estimado aumento del 70% en la demanda mundial de alimentos que se prevé para 2050 (Burney et al., 2010). Frente al dilema de cómo satisfacer la creciente demanda de alimentos manteniendo la capacidad de los ecosistemas de generar otros servicios a largo plazo (Foley et al., 2005; Kiers et al., 2008), algunas voces argumentan que los déficits locales de alimentos responden a una desigual distribución de los mismos y no a la cantidad global de alimentos producidos (Fischer et al., 2011). Aproximadamente 2.500 millones de personas en el mundo viven de la agricultura y la ganadería (FAO, 2012), la mayoría de ellas a través de producciones de pequeña escala, que suelen ser más eficientes en el uso del agua, los nutrientes y la energía, contribuyendo además a la conservación de la biodiversidad sin sacrificar la productividad (Kiers et al., 2008). Estos argumentos, entre otros, fueron los que llevaron al relator especial de Naciones Unidas a llamar la atención sobre la importancia de los modelos de producción campesina (como los propuestos por la Agroecología y la Soberanía Alimentaria) a pequeña escala, con vistas a la satisfacción de las necesidades de alimentos de las poblaciones (de Schutter, 2010).

El papel de los agroecosistemas y de las áreas rurales en general no se reduce, sin embargo, a la producción de alimentos, de forma que **otros servicios de los ecosistemas** como el disfrute estético de los paisajes culturales, el turismo rural, el control de plagas o la polinización son cada vez más valorados (ej., MEA, 2005; Gómez Sal y González García, 2007; Kiers et al., 2008; Carpenter et al., 2009; Harrison et al., 2010; Lamarque et al., 2011b). Hay cada vez más voces que resaltan cómo algunos usos agrarios pueden sostener elevados niveles de biodiversidad, especialmente en regiones históricamente agrícolas (Altieri y Koohafkan, 2004; Ellis et al., 2010). La capacidad de los agroecosistemas para generar múltiples servicios ha sido reconocida por varias instituciones.

Por un lado, la auditoría internacional llevada a cabo bajo el auspicio de cinco organismos de Naciones Unidas, el Banco Mundial y el Fondo para el Medio Ambiente Mundial en 2008 bajo el título de la "Evaluación Internacional del Conocimiento, Ciencia y Tecnología en el Desarrollo Agrícola", sugiere que: "*la adopción de un planteamiento multifuncional para aplicar los conocimientos, la ciencia y la tecnología agrícolas producirá un mayor impacto en el hambre y la pobreza, al mejorar la nutrición y los medios de subsistencia de las personas de manera equitativa y sostenible desde el punto de vista ambiental, social y económico. Con el concepto de* ***multifuncionalidad*** *se reconoce la ineludible interrelación entre las diversas funciones de la agricultura; es decir, la agricultura es una actividad que genera numerosos elementos, no sólo productos* *básicos, sino también de otra índole: servicios ambientales, mejoras en los paisajes y legados culturales.*" Por otro lado, y desde los años 90, la multifuncionalidad de los agroecosistemas se ha adoptado como componente fundamental de la Política Agrícola Común (PAC) y se ha incorporado tanto en ámbito científico como político (Gómez Sal y González García, 2007; Marsden y Sonnino, 2008; Renting et al., 2009).

La multifuncionalidad de los agroecosistemas está especialmente relacionada con aquellos sistemas manejados de manera tradicional. Fischer et al. (2010) caracterizan las **prácticas agrarias tradicionales**[3] en función de cuatro elementos socioeconómicos: (1) la rotación de usos y la combinación de ganadería, agricultura y gestión forestal; (2) formas de extracción de recursos que requieren de gran fuerza de trabajo pero escasos insumos de nutrientes, mecánicos y de aplicación de pesticidas; (3) una orientación hacia la producción de subsistencia o mercados locales; y (4) tradiciones culturales y normas que evolucionan para mantener esos agroecosistemas, incluyendo el conocimiento ecológico tradicional y diversidad de instituciones formales y no formales.

A pesar de su carácter multifuncional, las evaluaciones de los servicios generados por los agroecosistemas hasta el momento se han focalizado en comprender el suministro de uno o dos servicios, principalmente de abastecimiento, ignorando los procesos ecológicos subyacentes al suministro del conjunto de servicios (Power, 2010). En cierta medida, esta focalización en la dimensión productivista de los agroecosistemas se ha visto acentuada desde mediados del siglo pasado, cuando bajo la llamada Revolución Verde, los países occidentales han llevado a cabo una **industrialización de la agricultura** (Rodríguez Zúñiga et al., 1980; Harrison et al., 2010) con vistas a la maximización del suministro de unos pocos servicios de abastecimiento, lo que a su vez conlleva la simplificación de los sistemas agrícolas (Sans, 2007) y la pérdida de biodiversidad (Norris, 2008).

Sin embargo, los servicios de abastecimiento dependen de los servicios de regulación y culturales, ya que éstos son insumos de la producción (Zhang et al., 2007; Power, 2010). La disminución en el suministro de los servicios de regulación y determinados servicios culturales genera frecuentemente una mayor dependencia de insumos externos para la producción de servicios de producción de alimentos (Sans, 2007).

[3] En España existe una amplia literatura sobre las prácticas y los sistemas agrarios tradicionales, entre cuyos autores destacan Naredo, Martínez Alier, García Delgado o González de Molina.

Por este motivo, en los agroecosistemas resulta esencial entender los ***trade-offs*** y los ***bundles***. Por ejemplo, las prácticas agrarias intensivas que maximizan el suministro de determinados servicios de abastecimiento (i.e., alimentos) pueden ser responsables de la pérdida y fragmentación de hábitats, de cargas excesivas de nutrientes o la emisión de gases de efecto invernadero, afectando así negativamente el flujo de los servicios de regulación (ej., Foley et al., 2005; McIntyre et al., 2009; CBD, 2010; Gordon et al., 2010), dando lugar a *trade-offs*. En cambio, la presencia de un hábitat adecuado para polinizadores contribuye a la protección de la biodiversidad, al control de plagas, a la calidad del agua y el suelo y a la belleza escénica de los paisajes rurales (Wratten et al., 2012), constituyendo un *bundle* de servicios.

La cuarta Evaluación Ambiental Europea mostraba sensibles mejorías en relación a la mitigación de algunos de los *trade-offs* de la agricultura, en concreto debido a la disminución del uso de pesticidas y el descenso de la ganadería (EC, 2002; EEA, 2007), pero continuaba mostrando la preocupación por esta problemática (Harrison et al., 2010). Desde el proyecto RUBICODE [4] se puso de manifiesto que la amplia simplificación de los agroecosistemas causó, especialmente entre 1950 y 1990, una degradación de los servicios culturales. En cambio, en las últimas dos décadas en muchas zonas de Europa, el turismo rural junto con el aumento de la apreciación estética y el patrimonio cultural ligados a los paisajes rurales, están dando lugar a tendencias diversas (Harrison et al., 2010).

En España, de los 25 servicios evaluados por EME (2011) en los agroecosistemas, el 68% mostraron una situación preocupante: diez de ellos se deterioran (el 40%), nueve aumentan y siete no cambian pero pierden importancia relativa. Sin embargo, cinco de los servicios que aumentan son servicios culturales que, sin embargo, van acompañados de una pérdida de la identidad y el legado de conocimientos propio de las sociedades rurales, de las que depende históricamente el manejo de los agroecosistemas (EME, 2011).

[4] El proyecto RUBICODE (Rationalizing biodiversity conservation in dynamic ecosystems; http://www.rubicode.net), promovido por la el sexto programa marco de la Comisión Europea, tenía como objetivo estudiar cómo contribuye la biodiversidad al bienestar humano.

Estos datos ponen de relevancia la enorme importancia que entraña el estudio de los agroecosistemas como sistemas socio-ecológicos, de manera tal que **los compromisos y sinergias sean analizados y gestionados con el objetivo de promover formas de manejo adecuadas que permitan satisfacer la demanda de alimentos, en cada contexto ecológico y socio-económico, sin comprometer con ello la sostenibilidad y el suministro del resto de servicios**.

Desde los años 50 del pasado siglo, una serie de **impulsores de cambio** como la mecanización de la agricultura y la ganadería, el aumento de la población y la globalización económica, han cambiado radicalmente las tradicionales prácticas agrícolas, forestales y ganaderas en Europa. Diversos condicionantes socioeconómicos como las migraciones hacia áreas urbanas y la entrada en vigor de **la Política Agrícola Común (PAC) de la Unión Europea** a raíz de la necesidad de garantizar la seguridad alimentaria de los europeos tras la segunda guerra mundial, han llevado, en determinadas zonas de Europa, al abandono de prácticas tradicionales, afectando a algunos servicios de los ecosistemas (Grove y Rackham, 2003; Harrison et al., 2010; EME, 2011; Plieninger et al., 2013). Desde los años 80 en la Unión Europea, la PAC ha sido el mecanismo político que más ha influido en los agroecosistemas y en las dinámicas socio-económicas en el medio rural de la cuenca mediterránea, siendo además el mayor esquema de apoyo al sector agrario del mundo.

Esta política agrícola ha tenido una influencia capital en el manejo de los agroecosistemas, con importantes efectos en la multifuncionalidad de los mismos, su biodiversidad y el mantenimiento de los servicios de los ecosistemas (ej. Marini et al., 2011; McIntyre et al., 2009; García-Llorente et al., 2012). En la Unión Europea, además, los Sistemas Agrarios de Alto Valor Natural (SAVN, o HVN por sus siglas en inglés) son reconocidos como importantes generadores de servicios de los ecosistemas, siendo el soporte de economías sostenibles y del rico tejido social de muchas zonas rurales (Beaufoy et al., 2012).

En el caso de **España**, la intensificación agraria ha sido tardía en comparación con zonas más septentrionales de Europa, por lo que numerosas prácticas agrarias tradicionales extensivas están aún presentes y asociadas a SAVN (Caraveli, 2000). Asimismo, en al menos un 42% de la superficie ocupada por hábitats de la Red Natura 2000 en España, se dan usos agrarios (Oñate, 2007). Tras la fuerte caída de población rural que tuvo lugar en España desde los años 60 del pasado siglo hasta el inicio de la década de los 90 (Gómez-Sal et al., 2011), en términos absolutos la población del medio rural ha experimentado un crecimiento entre 1990 y 2008 (MAGRAMA, 2010).

Sin embargo, la población rural va perdiendo peso paulatinamente respecto al total de la población española (MAGRAMA, 2010) y el empleo en el sector agrícola continúa disminuyendo (Burgaz, 2009; Gómez-Sal et al., 2011) como consecuencia del abandono de las actividades agrarias extensivas, de la simplificación y la especialización, así como de la intensificación agraria.

Las políticas rurales de los últimos años no han sido eficientes en frenar el declive que ha llevado a la intensificación en algunas zonas y al abandono en otras, a pesar de los amplios fondos que llegan de la Unión Europea (Beaufoy et al., 2012). Los fondos se han orientado preferentemente a las repoblaciones forestales en suelos marginales, con la retirada de las actividades humanas, y las medidas agroambientales se han desarrollado muy lentamente, cubriendo una superficie limitada en comparación con muchos países europeos.

Según EME *"la intensificación afecta por una parte a la pérdida de elementos relevantes constitutivos del paisaje agrario y conlleva la ineficacia de procesos ecológicos que se mantenían activos por efecto del manejo humano, entre estos la recuperación de la fertilidad -gestión de la materia orgánica-, la herbivoría -papel de los herbívoros pastadores- o la gestión conservativa del ciclo del agua (Gómez Sal, 1997, 2011)".*

1.3. La ganadería nómada en el mundo y la trashumancia en España

La superficie terrestre libre de hielo dedicada al pastoreo ha aumentado de un 3% en 1700 a un 26% en 2000, convirtiéndose, en el último siglo, en el "antroma" [5] dominante (Ellis et al., 2010). La expansión de los pastizales tras la revolución industrial (desde 1900) ha sido el mayor cambio de uso del suelo en términos de superficie global (Ellis et al., 2010). Los **pastizales** permanentes mantenidos por la ganadería extensiva cubren el 26% de la superficie terrestre del planeta (FAO, 2013) y aproximadamente un tercio del área agrícola de la Unión Europea. En España, los pastizales naturales y los

[5] Los "antromas", también conocidos como "biomas antropogénicos" o "biomas humanos" se definen como "los patrones ecológicos globalmente significativos creados y sostenidos por las interacciones entre seres humanos y ecosistemas" (Ellis y Ramankutty, 2007).

matorrales, es decir, los agroecosistemas más estrechamente vinculados (aunque no los únicos) a la ganadería extensiva, se estima que representan entre un 18% (EME, 2011) y un 28% (Beaufoy et al., 2012), del territorio nacional. Grandes superficies de pastos están además clasificadas como bosques, por lo que no suelen ser contabilizadas en estas estimaciones. De hecho, el uso ganadero de los bosques en España es uno de los principales, tal y como refleja la Estrategia Forestal de España (MIMAM, 1999), que estima una superficie de pastizales permanentes tres veces mayor (20 millones de hectáreas) que la que muestran las estadísticas agrarias. A pesar de que los pastizales han sido reconocidos por su elevado valor para la sociedad europea (ej. Lamarque et al., 2011b; Beaufoy et al., 2012), están amenazados por una serie de impulsores de cambio, principalmente los cambios de usos del suelo, el manejo intensivo o el abandono (MacDonald et al., 2000; Gibon, 2005).

La **ganadería extensiva o pastoralismo** sustenta cerca de 200 millones de hogares a través de rebaños que suman cerca de mil millones de cabezas de ganado y que generan cerca del 10% de la producción de carne del mundo (FAO, 2001). Su importancia a nivel económico a escala mundial y en concreto en grandes superficies de los continentes africano y asiático, también ha sido reconocida (Rodríguez, 2008). Las prácticas de manejo ganadero extensivo son reconocidas como una herramienta clave para la sostenibilidad (ej. Blondel, 2006; Mortimore et al., 2009) y el mantenimiento de la biodiversidad y los servicios de los ecosistemas (Huntsinger y Hopkinson, 1996; Plieninger et al., 2012), siendo especialmente importantes en los ecosistemas de montaña y áreas rurales (Hatfield et al., 2006). En la cuenca mediterránea, se ha subrayado su estrecha relación con SAVN (Baldock et al., 1993; Beaufoy et al., 1994). En España, el reciente trabajo de Oppermann et al. (2012) sobre los SAVN, hace un llamamiento sobre el predominante papel de la ganadería extensiva por la gran superficie de hábitats de importancia europea (Natura) que contribuye a conservar.

Entre las diversas formas de manejo ganadero extensivo, el **pastoralismo nómada** es una forma particular que se basa en la migración del ganado y los pastores. Constituye una adaptación típica de zonas semi-áridas donde la disponibilidad natural de recursos es muy variable en el tiempo y en el espacio (Dyson-Hudson y Dyson-Hudson, 1980; Fryxell y Sinclair, 1988; Alerstam, et al. 2003). De hecho, el pastoralismo móvil ha sido tradicionalmente dominante en áreas de los trópicos semi-áridos, en desiertos, zonas de elevada altitud o en áreas subárticas (Manzano-Baena y Casas, 2010), llamadas en ocasiones "tierras marginales" (MARM, 2011). La característica común de estas zonas es que en todas ellas se dan grandes contrastes climáticos entre estaciones, ya sea en términos de temperatura o de precipitación, que afectan a la productividad vegetal (inestabilidad temporal), así como grandes variaciones en la productividad causadas por diferencias orográficas o de sustrato (inestabilidad espacial) (MARM, 2011). Por tanto, el calendario pastoral responde a las oscilaciones climáticas y de la productividad primaria del ecosistema en que se asientan, incitando al desplazamiento del ganado herbívoro hacia zonas complementarias en producción de pasto a lo largo de un gradiente temporal (Gómez Sal, 2001). Los movimientos periódicos de ganado permiten adaptar la presión ganadera a la capacidad de carga de los ecosistemas y hacer un uso eficiente de la productividad primaria en cada estación (Fryxell et al., 1988; Alerstam et al., 2003) al tiempo que se reduce la vulnerabilidad del ganado frente a posibles riesgos ambientales locales (Kaimba et al., 2011).

Los pastores se especializan en averiguar, bien a través de percepción de indicadores ambientales o a través del intercambio de información establecido en las redes sociales, dónde va a darse un pico de productividad primaria aprovechable (MARM, 2011). Por otro lado, la calidad de los pastos en términos de nutrientes es sensiblemente mayor en sistemas sometidos a fuerte sequía estacional, lo que supone una motivación más para la ganadería nómada (Fryxell and Sinclair, 1988).

La **trashumancia** es una forma de pastoralismo nómada que aparece en ambientes de contrastes climáticos marcados pero predecibles (MARM, 2011), por lo que se basa en el movimiento fluctuante entre dos extremos, en latitud (de largo recorrido) y/o altitud. Por tanto, se trata de una movilidad adaptada a picos de productividad primaria relativamente previsibles espacial y temporalmente, entre zonas llamadas de agostada e invernada (Ruiz y Ruiz, 1986). Así, a finales del otoño se traslada el ganado a zonas bajas y/o a latitudes más templadas (más meridionales en el hemisferio norte) donde los pastos pueden crecer o bien existe ramón, rastrojos de cultivos de cereales o restos de cultivos agrícolas disponible para el ganado durante el invierno. Durante la primavera el ganado se desplaza hacia zonas montañosas, con temperaturas más frescas (más septentrionales en el caso del hemisferio norte) y mayor disponibilidad de agua y pastos, tanto permanentes como de rastrojo. Además ambos viajes suelen coincidir con los picos de productividad de las zonas intermedias que atraviesan los rebaños entre los pastos de verano y los de invierno (Manzano Baena y Casas, 2010).

La organización social o institucional en defensa de la actividad trashumante no es homogénea a lo largo del planeta. En países "desarrollados", principalmente de la Unión Europea, la **defensa de la trashumancia** se ha articulado fundamentalmente desde plataformas compuestas por científicos que han tomado conciencia de la importancia del pastoreo para los procesos ecológicos (MARM, 2011). En este contexto surgió el proyecto "TRANSHUMOUNT: una revisión del papel de la trashumancia en los procesos y dinámicas de montaña", que se desarrolló entre 2003 y 2004 en el quinto programa marco de la Unión Europea, y en el que se recopiló información de Austria, Alemania, España, Francia, Reino Unido, Grecia, Italia, Polonia, Portugal, Rumanía y Eslovaquia. Existen casos documentados además para Bulgaria, Irlanda y Suecia en el Foro Europeo para la Conservación de la Naturaleza y el Pastoralismo[6].

Por lo general, los colectivos de pastores en la mayoría de países son débiles y marginales, tanto en el seno de los movimientos sindicales agrarios, como de cara a la sociedad y a los tomadores de decisiones. Fuera de las fronteras de Europa, en cambio, en los países comúnmente conocidos como en vías de desarrollo, las plataformas de apoyo al pastoreo están mayoritariamente compuestas por pastores (UICN, 2011) y la comunidad científica no tiene gran capacidad de influir políticamente. Las reivindicaciones de los pastores (numerosos y con gran capacidad de movilización en muchos casos) están más ligadas a cuestiones culturales y de derechos sobre la tierra y sus voces alcanzan foros como el Comité de Seguridad Alimentaria de la FAO (MARM, 2011).

A nivel institucional formal, en el **ámbito internacional** el papel del pastoreo ha sido reconocido en tres de las convenciones establecidas por Naciones Unidas en la Cumbre de la Tierra de Río de Janeiro de 1992 (MARM, 2011). En la Convención de Lucha Contra la Desertificación y la Degradación del Suelo se establece que la degradación del suelo en zonas pastoriles suele estar ligada a la sedentarización de pastores, a la restricción de la movilidad y a la intensificación de la gestión ganadera, al régimen de tenencia de la tierra y al debilitamiento de las instituciones tradicionales. En la Convención sobre Diversidad Biológica se reconoce que se ha comprobado que el pastoreo tradicional extensivo tiene un valor en general muy positivo en la conservación de la biodiversidad, para mantener abiertos importantes corredores ecológicos gracias a

[6] European Forum for Nature Conservation and Pastoralism: http://www.efncp.org/.

las migraciones y en la prevención de incendios catastróficos por acción de la herbivoría. En la Convención Marco sobre Cambio Climático, se establece que los pastizales muestran un enorme potencial como sumideros de carbono y que la estrategia de vida pastoralista móvil y la tenencia comunal de la tierra hace a los pastores considerablemente más adaptativos y minimiza el riesgo que éstos corren en lugares de precipitación errática y muy concentrada.

Por último, la Organización Mundial de las Naciones Unidas para la Agricultura y la Alimentación (FAO) inició en el año 2002 un amplio programa para la conservación y manejo adaptativo de los Sistemas Ingeniosos del Patrimonio Agrícola Mundial, entre los que se encuentran los sistemas pastoriles nómadas y semi-nómadas, y que son definidos como "*Sistemas destacables de uso de la tierra y paisajes, ricos en diversidad biológica, de importancia mundial, que evolucionan a partir de la co-adaptación de una comunidad con su ambiente y sus necesidades y aspiraciones, para un desarrollo sostenible*" (Koohafkan y Altieri, 2011). Esta iniciativa pretende "*promover el entendimiento, la sensibilización y el reconocimiento nacional e internacional de los sitios del Patrimonio Agrícola, buscando la salvaguarda de los bienes y servicios sociales, culturales, económicos y ambientales que ellos proveen a los agricultores familiares, pequeños productores, pueblos indígenas y comunidades locales, a través del fomento de un enfoque integrado combinando agricultura sustentable y desarrollo rural*" (Koohafkan y Altieri, 2011).

En **España**, en el transcurso de la realización de esta Tesis Doctoral, se ha elaborado el Libro Blanco de la Trashumancia (MARM, 2011), el cual reconoce el importante papel de la actividad trashumante para el mantenimiento de un flujo diverso de servicios de los ecosistemas: servicios de regulación (como la conectividad y la dispersión de semillas, la prevención de incendios, la fertilización del suelo o la conservación de la biodiversidad), de abastecimiento (como la carne de calidad) y culturales (como la identidad cultural y el conocimiento ecológico tradicional) (Gómez Sal y Lorente, 2004; Mangas-Navas, 2004; Bunce et al., 2006; Manzano y Malo, 2006). Por otro lado, desde 1995, La Ley de Vías Pecuarias (Ley 3/1995 de 23 de Marzo) crea la denominada Red Nacional de Vías Pecuarias, "*en la que se integran todas las cañadas y aquellas otras vías pecuarias que garanticen la continuidad de las mismas, siempre que su itinerario discurra entre dos o más Comunidades Autónomas y también las vías pecuarias que sirvan de enlace para los desplazamientos ganaderos de carácter interfronterizo*" (art. 18.1). Esta

Ley reconoce que las vías pecuarias "*también han de ser consideradas (...) como auténticos corredores ecológicos, esenciales para la migración, la distribución geográfica y el intercambio genético de las especies silvestres*".

Más allá de las dimensiones ecológicas y políticas, el pastoralismo nómada y la trashumancia no son meras formas de manejo ganadero sino que constituyen formas de vida que requieren de la adaptación a condiciones complejas (MARM, 2011). Se habla a menudo de la **cultura pastoril** como el conjunto de adaptaciones de los pastores a las condiciones ambientales, el uso del derecho consuetudinario y las instituciones tradicionales, la gestión comunal de las tierras como herramienta para minimizar el riesgo ante la gran variabilidad espacial de la producción vegetal a pequeña escala, la cultura de monitoreo del estado de los pastizales, la especialización de mujeres, hombres, jóvenes y niños en diversas tareas relevantes para el conjunto de la comunidad, la confianza en el poder de las personas ancianas como repositorio del saber ante posibles perturbaciones periódicas pero espaciadas en el tiempo, entre otras (MARM, 2011).

Este acervo cultural está indisolublemente ligado al mantenimiento de las vías pecuarias. Las rutas del ganado deben satisfacer el conjunto de necesidades y vida social de los pastores, incluyendo el comercio, las ceremonias y los compromisos familiares, así como permitir hacer nuevos contactos, adquirir información, desarrollar conocimientos y educación, por lo que para algunas comunidades la movilidad es de vital importancia (Sulieman, 2013). Fruto de este acervo cultural y del intercambio con, o la diferenciación respecto de otras poblaciones, surge además en ocasiones la identificación comunitaria o étnica (MARM, 2011). En España la declaración de la trashumancia en Aragón como Bien de Interés Cultural Inmaterial (BIC) constituye precisamente un ejemplo de visibilización de estos valores culturales.

Sin embargo, a pesar de los esfuerzos que se han realizado para la puesta en valor de la ganadería extensiva en general y de la trashumancia en particular, por sus ventajas adaptativas, por los servicios generados por los ecosistemas que contribuye a conservar y por sus valores culturales, estas formas de manejo ganadero están en declive. La intensificación de la ganadería en aras de sistemas más productivistas a costa de mayores insumos ha tenido consecuencias negativas para la biodiversidad y los servicios de los ecosistemas, especialmente en las zonas marginales tradicionalmente aprovechadas por el pastoreo (Pineda, 2001). La ganadería extensiva se considera una de las estrategias vitales más vulnerables del mundo en el contexto del cambio global, ya que se ve afectada por diversos **impulsores de cambio** (ej. Altieri y Koohafkan, 2004; Fernández-Giménez y Le Febre, 2006; Nori y Davies, 2007; Dong et al., 2011).

Entre los impulsores que más afectan al pastoralismo nómada en concreto se encuentran la integración progresiva en la economía de mercado, las políticas de sedentarización, la expoliación o el acaparamiento de tierras, y las limitaciones institucionales que dificultan la movilidad de las poblaciones nómadas (Davies y Hatfield, 2007; WISP 2008; Galvin, 2009; Sulieman, 2013). A lo largo de los siglos, los ganaderos han sido paulatinamente desplazados no sólo geográfica sino también económica y socialmente, en un proceso que se ha acentuado durante el siglo XX (Ruiz, 2001). La combinación de estos factores con algunos de los principales impulsores directos del cambio global como el cambio climático o los cambios de usos del suelo, hacen que la pervivencia de la ganadería extensiva nómada y, por lo tanto, de los servicios de los ecosistemas y los valores ecológicos, socio-culturales y económicos asociados a esta práctica, supongan un desafío (Nori y Davies, 2007).

1.4. Objetivos de la tesis

El estudio de la ganadería extensiva nómada ha tenido históricamente, desde los años 40, un gran atractivo romántico en algunas ramas de la academia como la antropología (Dyson-Hudson y Dyson-Hudson, 1980). La literatura sobre la historia y los aspectos económicos de la trashumancia en España no puede considerarse escasa (a pesar de que la historia de la ganadería en España ha sido ampliamente obviada en los ensayos de historia agraria, Domínguez Martín, 2001). Desde el clásico trabajo de Klein (1920) hasta el de Manzano y Casas (2010), pasando por Ruiz y Ruiz (1986) y García Martín (2004), hay decenas de publicaciones, algunas de ellas especialmente centradas en determinadas zonas de la Península Ibérica (ej. Castán Esteban, 2004; O'Flanagan et al., 2011).

En general, la mayoría de las investigaciones realizadas en España hasta la fecha en torno a la trashumancia se han caracterizado por las aproximaciones sectoriales (desde la historia, la economía, la antropología o la ecología) por lo que este trabajo no pretende incidir concretamente en una visión especializada.

En este sentido, el **objetivo general** de la presente Tesis Doctoral es *explorar, desde el marco conceptual y las herramientas propias de las Ciencias de la Sostenibilidad, el papel que desempeñan las prácticas agrarias tradicionales (y en particular la trashumancia) en la generación de servicios de los ecosistemas y sus implicaciones para la sostenibilidad y resiliencia de los agroecosistemas de la cuenca mediterránea.*

Para ello, se plantean los siguientes **objetivos específicos**:

1. Analizar el panorama de conocimiento existente sobre los servicios generados por los agroecosistemas de la cuenca mediterránea, identificando vacíos de conocimiento en la literatura científica y necesidades de investigación;
2. Desarrollar un marco conceptual y metodológico para el estudio de los vínculos entre una práctica agraria tradicional concreta (la trashumancia) y el bienestar humano, a través de las contribuciones realizadas por los ecosistemas asociados con la trashumancia a la sociedad (*i.e.,* servicios de los ecosistemas);
3. Evaluar los servicios suministrados por los ecosistemas asociados con la práctica trashumante desde la dimensión socio-cultural y explorar los factores que subyacen a las preferencias sociales por los mismos;
4. Explorar, bajo la perspectiva de la resiliencia socio-ecológica y los servicios de los ecosistemas vinculados a la trashumancia, la evolución y los cambios de esta práctica en el pasado, el contexto presente y las posibles incertidumbres y oportunidades en el futuro próximo;
5. Proponer medidas y acciones concretas (a desarrollar desde distintas escalas institucionales y temporales) que contribuyan a la sostenibilidad social económica y ecológica de la ganadería trashumante.

1.5. Estructura de la tesis

La presente Tesis Doctoral[7] está basada en siete publicaciones, cada una de las cuales tiene identidad propia, y que, en su conjunto, pretenden responder a los objetivos planteados en esta investigación tal y como se representa en la Fig. 1.3.

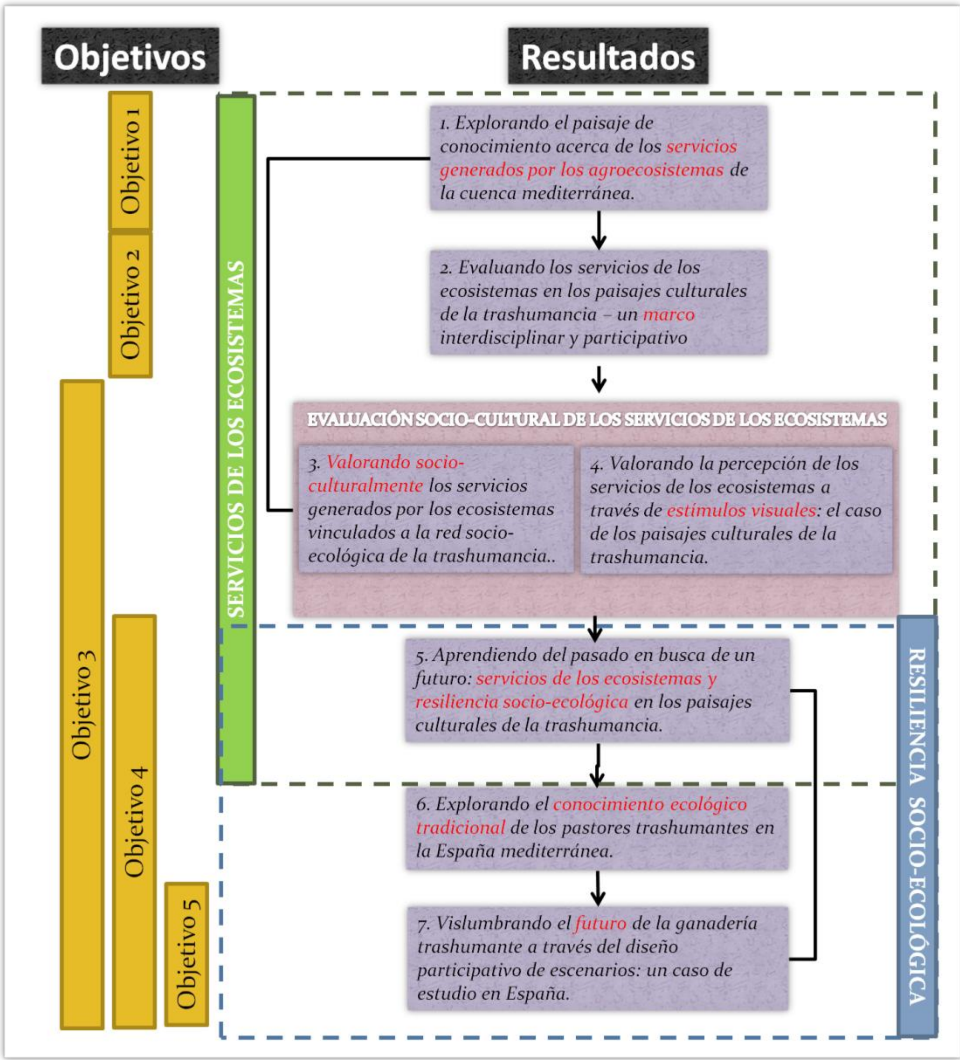

Figura 1.3. Estructura de la Tesis Doctoral en la que se vinculan los objetivos planteados en la investigación con los siete capítulos de resultados.

[7] La presente Tesis Doctoral se enmarca en el contexto más amplio del proyecto de investigación titulado "Valoración económica de la biodiversidad y los servicios de los ecosistemas ligados a la trashumancia en la Cañada Real Conquense: implicaciones para la gestión de los agroecosistemas mediterráneos en el contexto del cambio global" (Proyecto 079/RN08/02.1; http://www.uam.es/gruposinv/socioeco/ficha_proyecto_4.htm) financiado por el Ministerio de Medio Ambiente y Medio Rural y Marino, y desarrollado por el Laboratorio de Socioecosistemas de la Universidad Autónoma de Madrid entre los años 2009-2011. La presente memoria de Tesis Doctoral recoge algunos de los resultados de ese proyecto. Otros, relacionados con dicha investigación y en los que la doctoranda también ha contribuido, se recogen en algunas de las publicaciones que aparecen en el apartado "Otras publicaciones".

El **capítulo 4.1** aborda el objetivo 1 y constituye un análisis exploratorio, a través de una revisión bibliográfica sistemática, acerca del “estado del arte” en la evaluación de servicios vinculados a los agroecosistemas, a escala de la cuenca mediterránea. A través de la revisión de 165 trabajos científicos: (1) se analiza el estado actual y las tendencias en la evaluación de servicios, (2) se examinan los vacíos de información y los sesgos en el cuerpo de conocimiento, (3) se evalúan las interacciones entre los métodos de evaluación empleados, los servicios de los ecosistemas objeto de las evaluaciones, y las características de los agroecosistemas en las que se realizan.

En el **capítulo 4.2**, para abordar el objetivo 2, se conceptualiza el objeto de estudio como una “red socio-ecológica” y se plantea el marco metodológico para evaluar servicios de los ecosistemas asociados a prácticas trashumantes y proponer medidas y acciones que contribuyan a su pervivencia en el futuro. Dicho marco se estructura en cuatro fases secuenciales, que son: (1) la caracterización de la red socio-ecológica vinculada a la trashumancia desde el punto de vista socio-económico y ecológico, (2) la identificación preliminar y la caracterización de los servicios de los ecosistemas identificados en la red socio-ecológica, (3) la evaluación de los servicios de los ecosistemas y (4) la planificación participativa de escenarios de futuro, incluyendo el análisis de *trade-offs* y la propuesta de estrategias de manejo. La interdisciplinariedad y la participación se proponen como elementos transversales en el conjunto de la investigación. En este trabajo se presentan asimismo algunos resultados preliminares de la aplicación del marco al caso de estudio de la Cañada Real Conquense.

A partir de los resultados de los capítulos 4.1 y 4.2 y en respuesta al objetivo 3, se presentan dos capítulos (4.3 y 4.4) que exploran dos tipos de evaluación socio-cultural de los servicios generados por los ecosistemas vinculados a la trashumancia en el caso de la Cañada Real Conquense.

El **capítulo 4.3** presenta los resultados de la valoración mediante preferencias sociales, realizada a través de cuestionarios en el caso de la Cañada Real Conquense. En concreto se exploran las diferentes preferencias en función de la escala, individual o social, a la que se considere el bienestar. Asimismo, se analizan la percepción acerca de las tendencias que siguen los servicios de los ecosistemas, así como la percepción de los contextos espaciales y temporales en los que estos servicios son generados, y la influencia de las características socio-económicas de los actores sociales en sus preferencias. Por último, se explora la relación entre los servicios de los ecosistemas percibidos como más relacionados con la trashumancia y la vulnerabilidad de los mismos.

En el **capítulo 4.4** se presentan los resultados correspondientes a la evaluación, también a través de cuestionarios, mediante percepción visual (usando imágenes fotográficas como estímulos visuales), de los servicios asociados a paisajes vinculados a la trashumancia en la Cañada Real Conquense. A través de la comparación de preferencias y servicios de los ecosistemas percibidos por distintos actores sociales en dos pares de fotos correspondientes a dos sub-zonas del caso de estudio, se explora un nuevo método de valoración socio-cultural y se discute su utilidad y el interés de los resultados.

El **capítulo 4.5** corresponde al abordaje conjunto de los objetivos 3 y 4 y constituye el puente entre el análisis de los servicios de los ecosistemas y el análisis desde la perspectiva de la resiliencia socio-ecológica. A través de los resultados de la observación participante, entrevistas en profundidad y un análisis bibliográfico, se exploran los vínculos entre una selección de los servicios de los ecosistemas percibidos como más estrechamente vinculados a la trashumancia, y la resiliencia socio-ecológica de la trashumancia en la Cañada Real Conquense. Asimismo se hace un análisis histórico de la resiliencia de la red socio-ecológica de la Cañada Real Conquense a lo largo del último siglo.

El **capítulo 4.6** aborda los objetivos 3 y 4. A partir especialmente de los resultados de los capítulos 4.3 y 4.5, se hace un foco en el conocimiento ecológico tradicional vinculado a la trashumancia. A través de un inventario (realizado mediante entrevistas) de las prácticas, conocimientos y creencias vinculadas a la trashumancia, se desarrolla un cuestionario mediante el que se explora la tendencia que está siguiendo este conocimiento ecológico tradicional y su uso. Asimismo, se discute el interés de la trashumancia y el conocimiento ecológico tradicional asociado a la misma para la adaptación al cambio global.

Por último, en el **capítulo 4.7** se abordan los objetivos 3, 4 y 5. A través del diseño participativo de escenarios de futuro, se exploran los impulsores de cambio que más han influido en el pasado reciente de la trashumancia en la Cañada Real Conquense, así como los que actúan en el presente y/o pueden actuar en el futuro. En cada uno de los cuatro escenarios explorados se analizan los *trade-offs* de servicios y las posibles influencias en el bienestar humano, para después desarrollar propuestas de acciones y medidas de gestión relacionadas con la trashumancia para su preservación como práctica tradicional que contribuye a la conservación de ecosistemas y al bienestar humano.

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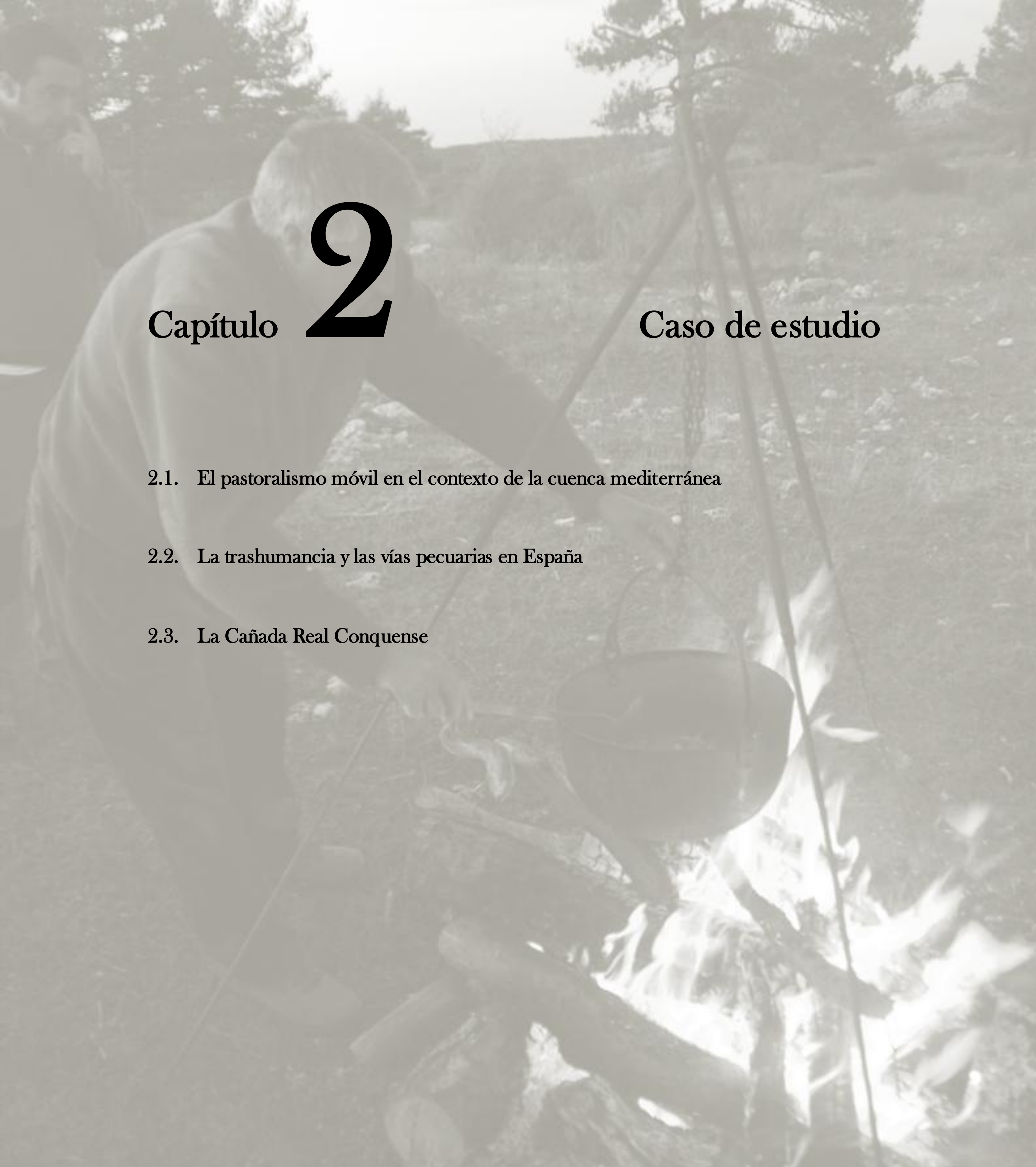

Capítulo 2 Caso de estudio

2.1. El pastoralismo móvil en el contexto de la cuenca mediterránea

2.2. La trashumancia y las vías pecuarias en España

2.3. La Cañada Real Conquense

2.1. El pastoralismo móvil en el contexto de la cuenca mediterránea

La cuenca mediterránea, como mosaico de paisajes naturales y culturales donde la civilización humana y la naturaleza han coexistido durante siglos (Blondel, 2006; Cuttelod et al., 2008), constituye un ejemplo paradigmático en la gestión de los agroecosistemas de manera sostenible. A pesar de ser una de las áreas más densamente pobladas por el ser humano, es reconocida a nivel internacional también como una de las áreas más ricas del mundo en especies y uno de los 25 "hotspots" de biodiversidad más significativos (Myers et al., 2000; CI, 2007). Precisamente esta relación entre el ser humano y la naturaleza, basada en sistemas de explotación combinada (fundamentalmente agricultura, silvicultura y ganadería), que adaptan los ciclos humanos a los naturales reforzando los procesos ecológicos, ha promovido la biodiversidad y la sostenibilidad a largo plazo (Schmitz et al., 2001). Según la Agencia Europea del Medio Ambiente, además, entre el 25 y el 50% de los hábitats protegidos de la Red Natura 2000 en los países del sur de Europa dependen de prácticas agrarias de baja intensidad para su conservación (EEA, 2006). Tal y como se ha reflejado en la introducción, los Sistemas Agrarios de Alto Valor Natural (SAVN) en la cuenca mediterránea y en especial en España, están estrechamente relacionados con determinadas prácticas agrarias (Oppermann et al., 2012). Sin embargo, la cuenca mediterránea es considerada una de las regiones del planeta más vulnerables al cambio global (MEA, 2005). Por estos motivos, constituye un interesante lugar para el estudio de los vínculos entre naturaleza y sociedad, entre el funcionamiento de los agroecosistemas y el bienestar humano. La cuenca mediterránea incluye 25 países diferentes (9 de ellos pertenecientes a la Unión Europea), y cubre una superficie de 207.147.600 ha (Fig. 2.1).

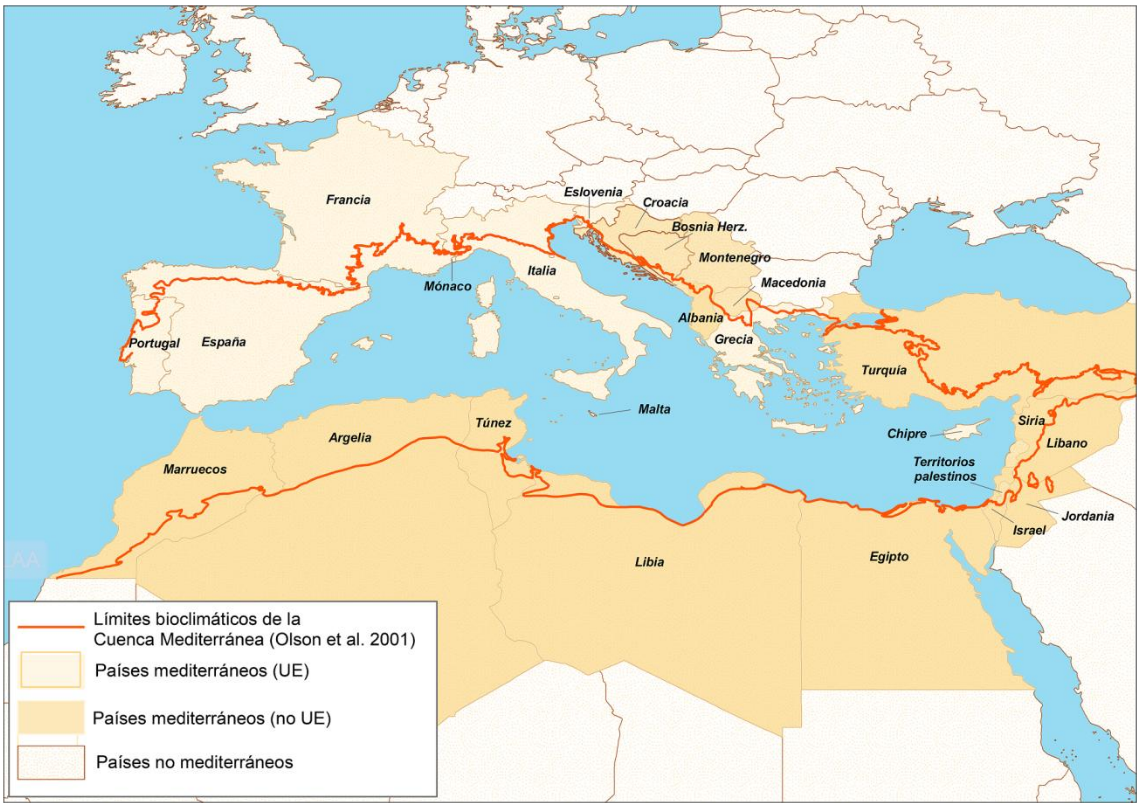

Figura 2.1. Delimitación bioclimática de la cuenca mediterránea según Olson et al., (2001) (Fuente: Nieto Romero, 2012).

Dado que la ecorregión de la cuenca mediterránea está determinada por una marcada estacionalidad y una orografía compleja (Gómez Sal y Lorente, 2004; Blondel, 2006) la productividad primaria se ve especialmente marcada por un patrón estacional y espacial (Gómez Sal, 2000). El clima mediterráneo se caracteriza, de hecho, por una gran variabilidad interanual en las precipitaciones y en la productividad primaria, lo que favorece el desarrollo de estrategias adaptativas en los herbívoros basadas en la migración estacional (Manzano Baena y Casas, 2010). Estas características justifican la amplia presencia de movimientos de ganado en la cuenca mediterránea, donde el pastoralismo desempeña, tal y como se ha mostrado en la introducción, un papel fundamental como práctica escultora de paisajes culturales y de SAVN (Blondel, 2006; Hatfield et al., 2006; Oppermann et al., 2012) (Fig. 2.2).

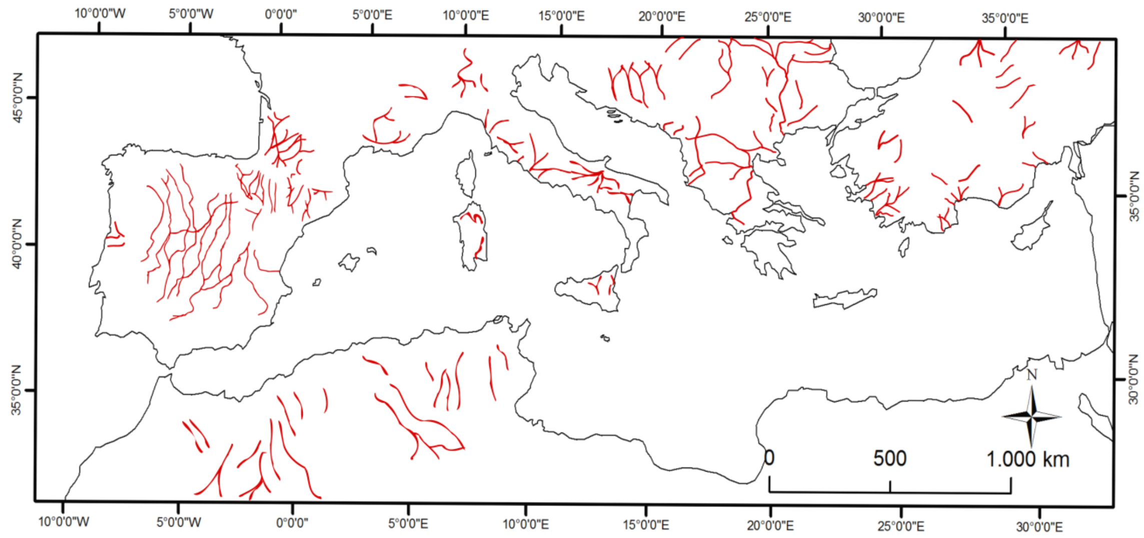

Figura 2.2. Mapa de los movimientos de ganado en la cuenca mediterránea (Fuente: elaboración propia a partir de Merino García y Alier Gándara, 2004).

Los primeros vestigios de trashumancia en la cuenca mediterránea datan de la Edad de Bronce, cuando los seres humanos seguían las rutas migratorias de los grandes animales salvajes, especialmente los venados (Blondel, 2006). Las distancias que cubrían y cubren los rebaños trashumantes actualmente van desde los 100-300 km en el sur de Francia, hasta los 500-700 km en España, el sur de Italia o África (Blondel, 2006). En Europa, la población pastoril está principalmente concentrada en la cuenca mediterránea y en los Balcanes, así como en las áreas montañosas de todo el continente (Bunce et al., 2004).

2.2. La trashumancia y las vías pecuarias en España

Las primeras referencias a rutas de ganados trashumantes datan del Fuero Juzgo Visigodo de los siglos VI y VII d.C. (Klein et al., 1920). Aunque parece que ya las poblaciones pre-romanas llevaban a cabo este tipo de prácticas, los romanos utilizaron estas rutas para construir muchos de sus caminos (Ruiz y Ruiz, 1986). Parece que las poblaciones bereberes provenientes del norte de África, tradicionalmente pastorales y nómadas, fomentaron y perfeccionaron en gran medida estas prácticas (Klein, 1920). El aumento de la presencia de ganado y, por lo tanto, de pastos en la Península Ibérica y el constante desplazamiento de fronteras facilitó el crecimiento de pastoralismo nómada, ya que los rebaños constituían un recurso móvil fácilmente trasladable durante los conflictos

(Klein, 1920). El constante movimiento de los ganados hacía de la actividad pastoril una interesante fuente de ingresos fiscales por el cobro de impuestos para el cruce de puertos y puentes o el arrendamiento de tierras por lo que gozó de especial atención por parte de los diversos gobiernos (Ruiz y Ruiz, 1986). La creación del Honrado Concejo de la Mesta a manos de Alfonso X, en 1273, representa un momento clave en la historia institucional, ya que supuso la unificación de las asociaciones de defensa de los derechos de los ganaderos y de los trashumantes, especialmente en relación a los conflictos con los agricultores. La trashumancia en España alcanzó su máximo auge en el siglo XVIII, tras un pico en los precios de la lana merina en el mercado holandés, llegando a alcanzar los tres millones y medio de cabezas de ovejas trashumantes en el siglo XVIII (Bilbao y Fernández Pinedo, 1982). Desde entonces la trashumancia en España ha ido en declive (Ruiz y Ruiz, 1986; García Martín, 2004). Especialmente a partir de principios de los años 40 del pasado siglo, con la entrada en funcionamiento del ferrocarril, se fue paulatinamente abandonando la trashumancia a pie (Bacaicoa Salaverri et al., 1993). Desde los años 60, el éxodo rural y la aparición de las fibras artificiales, así como, desde principios de los 90, la sustitución del transporte ferroviario por camiones, conllevaron un descenso aún más marcado de la trashumancia en España (Ruiz y Ruiz, 1986; Manzano Baena y Casas, 2010). En lo que va de siglo, en algunas zonas de España se han visto tímidos repuntes de esta actividad, en algunos casos posiblemente relacionados con algunas medidas de apoyo de la Política Agrícola Común (PAC) de la Unión Europea (O'Flanagan et al., 2011) y, en otros, con la mayor rentabilidad económica y adaptabilidad a los cambios que presenta este modelo ganadero (Fernández-Giménez y Fillat Estaque, 2012).

En España, en función de la longitud de los desplazamientos, se habla de tres **tipos de movimientos de ganado** (García Martín, 1990):

- *Trashumancia local*: desplazamientos cortos, realizados dentro de los límites de un mismo término municipal.
- *Transterminancia*: los desplazamientos se realizan entre varios términos municipales próximos entre sí.
- *Gran trashumancia* o *trashumancia regional*: los desplazamientos son de largo alcance con distancias normalmente superiores a 200 kilómetros y hasta los 700 kilómetros.

El éxito o viabilidad económica de estos distintos modelos difiere mucho en función de cada zona. Los movimientos cortos suelen ser más ventajosos en zonas más húmedas, como es el caso entre el Pirineo y el valle del Ebro (O'Flanagan et al., 2011) o zonas del centro y norte de Europa (Bunce et al., 2004, Huband et al. 2010). Las migraciones más largas, en cambio, son preferidas en ambientes de clima mediterráneo, donde los sistemas montañosos adyacentes a los pastos de invierno, durante el verano muestran condiciones de humedad poco favorables para el crecimiento del pasto y considerables restricciones en la disponibilidad de agua (Manzano Baena y Casas, 2010). Mientras que lo habitual en el mundo es que los rebaños trashumantes tengan su origen en tierras bajas y se desplacen en la estación cálida, durante 3 ó 4 meses a las zonas altas; en España, los grandes movimientos trashumantes más frecuentes se dan desde las montañas (Pirineos, Cordillera Cantábrica, Sistema Ibérico y Montes Universales principalmente) a los pastos de invernada donde permanecen entre 6 y 8 meses (Ruiz y Ruiz, 1986; Gómez-Sal y Rodríguez-Pascual, 1992; Lasanta, 2010). Por este motivo, los movimientos trashumantes en España también se han caracterizado como *"descendientes" o "inversos"* para distinguirlos de la mayoría de movimientos en el resto de Europa en que serían *"ascendientes" o "directos"* (Berezowski, 1971).

Los movimientos de ganado en España se dan a través de una extensa **Red de Vías Pecuarias** distribuidas a lo largo de toda la geografía, que con unos 125.000 km de longitud y 400.000 hectáreas de superficie abarcan entorno al 0,83% de la superficie nacional (Mangas-Navas, 1992) (Fig. 2.3). Según establece la *Ley 3/1995, de 23 de marzo de 1995, de Vías Pecuarias*, éstas en su conjunto forman un amplísimo sistema de caminos con distinta denominación, en función de su anchura: las *cañadas* (con un ancho de 75 m); los *cordeles* (con un ancho de 37,5 m); y las *veredas* (con un ancho no superior a 20 m). El origen de las cañadas como soporte de la trashumancia regional se remonta al siglo XII: *"Estas vías pecuarias se identifican gracias a algunos documentos medievales que atestiguan la imposición de ciertos gravámenes a los ganados trashumantes al pasar por determinados lugares, lo que indica el uso de unos caminos fijos, que hacia finales del siglo XII recibieron el nombre de cañadas"* (Klein, 1920). Sobre vías pecuarias la bibliografía es extremadamente abundante, abarcando aspectos legislativos, geográficos, históricos y ecológicos[8]. El gran patrimonio con que cuenta España en términos de vías

[8] Una revisión interesante y relativamente reciente sobre las vías pecuarias en España puede encontrarse en Merino García y Alier Gándara, 2004.

pecuarias y su protección legal mediante la Ley de Vías Pecuarias (Ley 3/1995) ha hecho posible el gran desarrollo de trabajos de investigación y la defensa de esta red pública estatal sin la que la trashumancia no sería posible[9].

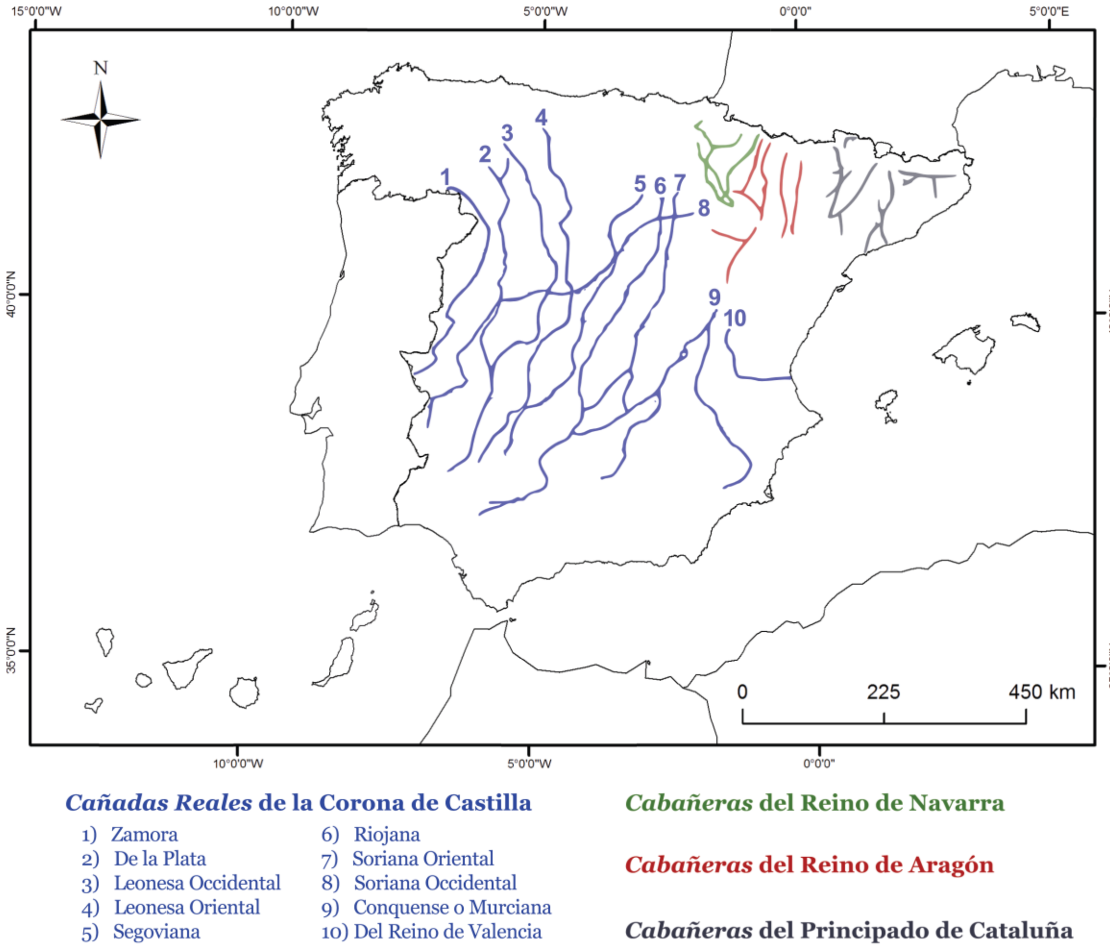

Figura 2.3. Mapa de las diez cañadas principales de la Red de Vías Pecuarias (elaboración propia a partir de Mangas Navas, 1992).

2.3. La Cañada Real Conquense

Como caso de estudio representativo de una práctica agraria tradicional de la cuenca mediterránea, la mayor parte del trabajo de investigación de la presente Tesis Doctoral (capítulos 4.2, 4.3, 4.4, 4.5, 4.6 y 4.7) se ha desarrollado en la Cañada Real Conquense (Fig. 2.4). Ésta es una de las diez cañadas reales principales de la Península Ibérica (Fig.

[9] Este interés se ha visto reflejado en la celebración de dos Congresos Nacionales de Vías Pecuarias en 2005 y 2010 en .los que se ha congregado una creciente comunidad de investigadores y personal técnico y administrativo interesado en este patrimonio.

2.3) y una de las pocas que mantiene aún un uso ganadero a pie en todo su recorrido, tanto con ganado ovino, como bovino de carne y de lidia. De acuerdo a los permisos oficiales emitidos por las Oficinas Comarcales Agropecuarias de la zona, **en el año 2009 un total de 87 pastores con casi 60.000 cabezas de ganado fueron trashumantes**. Desde los años 90 hasta el año 2009 se ha detectado un importante descenso, de casi un 60% en el número de ganaderos trashumantes y del 55% en el número de cabezas de ganado (Bacaicoa Salaverri et al., 1993; datos de las Oficinas Comarcales Agropecuarias de Cañete, Priego, Cuenca, Molina de Aragón y Albarracín). En el año 2009, **el 17% de las explotaciones (con cerca de 9.000 ovejas y 1.200 vacas) realizaron la trashumancia a pie.** El resto de ganaderías realiza el desplazamiento trashumante en camiones. Actualmente entre 13 y 17 explotaciones recorren a pie la Cañada Real Conquense cada primavera/otoño.

La Cañada Real Conquense constituye un ejemplo paradigmático y ofrece una oportunidad única para explorar la trashumancia como práctica agraria tradicional en el Mediterráneo desde la perspectiva de los sistemas socio-ecológicos, desde el pasado hasta el futuro, pasando por un presente activo. Aunque en cada uno de los capítulos de resultados se describe en concreto la delimitación de la zona de estudio adoptada en relación a los objetivos concretos, el sistema socio-ecológico asociado a la trashumancia en la Cañada Real Conquense se caracteriza por estar compuesto de tres áreas claramente diferenciadas: la zona de agostada, la propia vía pecuaria y la zona de invernada (Fig. 2.4).

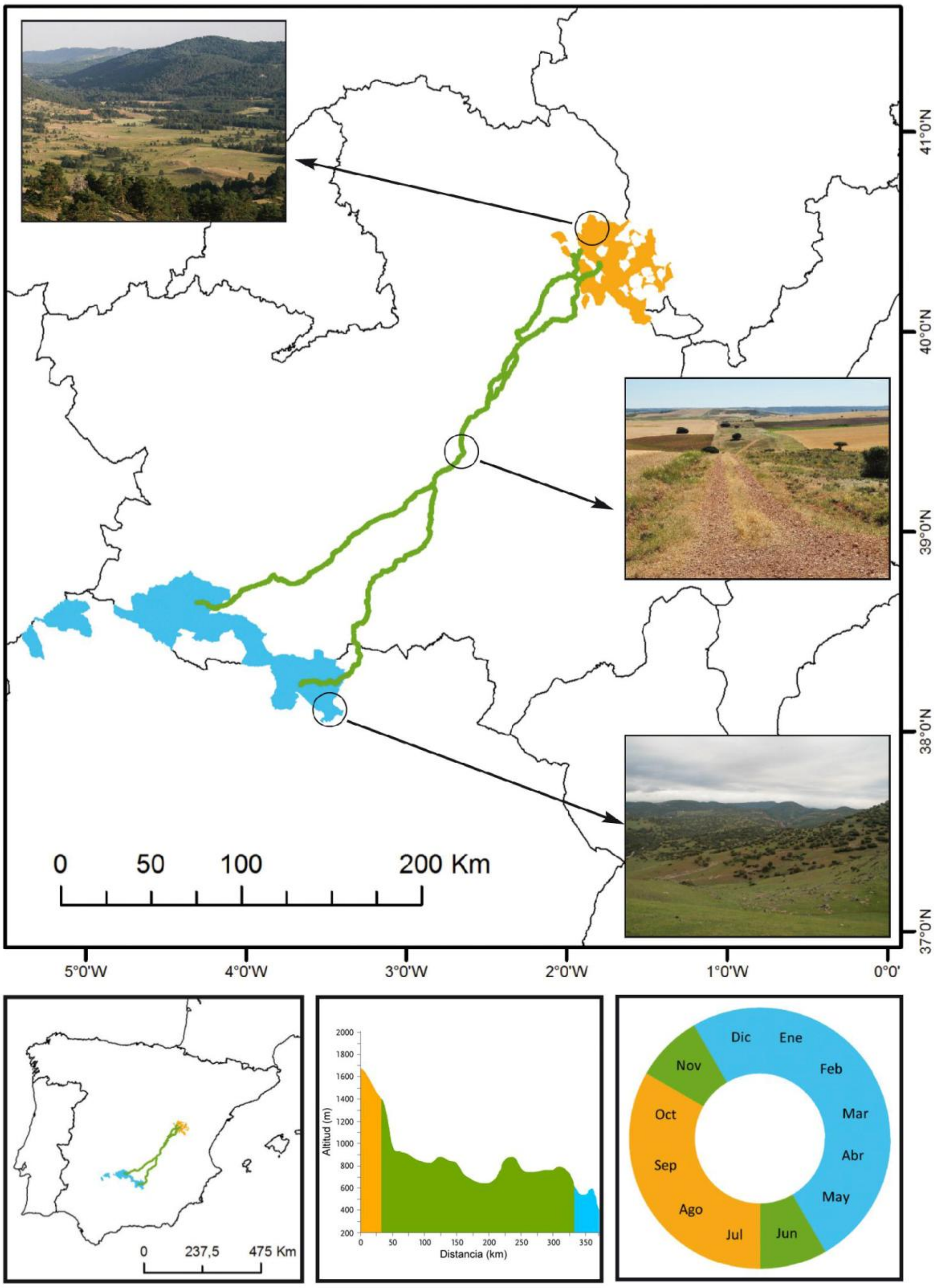

Figura 2.4. Mapa y fotografías de la Cañada Real Conquense y sus zonas de agostada e invernada (derecha). Localización en la Península Ibérica (superior izquierda), perfil altitudinal de la Cañada Real Conquense (central izquierda), ciclo anual de movimiento del ganado (inferior izquierda).

Zona de agostada. Es el territorio en el que el ganado pasa el verano, desde final de Junio hasta principios de Noviembre, cuando los pastos son mejores en esta zona y peores en la zona de invernada. Se encuentra situada en la zona oriental de los Montes Universales, entre las provincias de Teruel (Aragón), Cuenca y Guadalajara (Castilla-La

Mancha). La zona se encuentra entre los 1400 y 1900 m de altitud, la precipitación media anual es de 730-2000 mm y la temperatura media anual oscila entre los 5 los 15ºC. El paisaje de esta zona está dominado por bosques de coníferas, especialmente pinares y sabinares, entremezclados con áreas de cultivo de cereales que, tras ser cosechados son aprovechados como rastrojo. El principal uso del suelo en esta zona son los pastos y bosques, y los escasos labrados presentes son mayoritariamente de herbáceas. Gran parte de esta zona está ocupada por una Reserva Nacional de Caza (en Teruel), el Parque Natural del Alto Tajo (en Guadalajara) y el Parque Natural de la Serranía de Cuenca. Las principales actividades económicas giran en torno al sector servicios y la ganadería. Esta zona comprende una de las áreas menos densamente pobladas (entre 3 y 5 habitantes por kilómetro cuadrado) de España y de Europa, teniendo la población más envejecida (55 años de media) del conjunto del área de estudio. Por otro lado, la condición socioeconómica[10] de la población es la más alta de las tres zonas que comprenden el área de estudio.

La ***Cañada Real Conquense***. En los trabajos incluidos en la presente Tesis Doctoral se ha aplicado siempre una delimitación administrativa, es decir, se han incluido todos los municipios atravesados por la Cañada Real Conquense, en las provincias de Cuenca, Ciudad Real y Albacete (Castilla-La Mancha), así como en las provincias de Jaén y Córdoba (Andalucía). La longitud de la cañada es de entre 370 y 500 km, según el origen y destino de los rebaños, y este recorrido dura entre 20 y 27 días, desde finales de mayo hasta finales de junio en primavera y desde primeros de noviembre hasta primeros de diciembre en otoño. El rango de altitud abarca desde 1400 a 600 m, la precipitación media anual es de entre 360 y 800 mm y la temperatura media anual es de entre 7 y 18ºC. El paisaje de esta zona se caracteriza por cultivos de vid y cereales, así como bosquetes de encinas y pinares de repoblación en algunas zonas. Los usos del suelo más extendidos son de hecho los cultivos y la ganadería ovina. La Cañada Real Conquense atraviesa la Reserva de la Biosfera de La Mancha Húmeda y el Parque Natural de las Lagunas de Ruidera. La densidad poblacional es de 11 habitantes por kilómetro cuadrado y la media de edad es de 47 años. Esta es la zona con una peor condición socioecónomica de la zona de estudio.

[10] La condición socioeconómica es una clasificación del Instituto Nacional de Estadística (INE) que se obtiene combinando la información de las variables de ocupación, actividad y situación profesional a partir de la Encuesta de Población Activa. (http://www.ine.es/censo_accesible/es/glosario.html)

Zona de invernada. Es el territorio en el que el ganado pasa el inverno, desde principios de diciembre hasta final de mayo, cuando los pastos son mejores en esta zona y peores en la zona de agostada. Se encuentra ampliamente distribuida en las provincias de Ciudad Real (Castilla-La Mancha), Jaén y Córdoba (Andalucía), desde Sierra Morena oriental hasta el Valle de la Alcudia. La altitud oscila entre 400 y 600 m, la precipitación media anual es de entre 400 y 1200 mm y la temperatura media anual es de entre 12 y 19ºC. El paisaje de esta zona está dominado por dehesas de encinas y olivares por lo que se trata de una zona muy estrechamente vinculada al sector agrario. Se caracteriza por una menor presencia de pastizales y bosques y un mayor peso del sector ganadero, sobre todo bovino. Esta zona está en parte comprendida entre los límites del Parque Natural de Despeñaperros y el Parque Natural Sierra de Andújar. La principal actividad económica es la agricultura, con un especial peso del sector olivarero y la ganadería, tanto intensiva (porcino y aviar) como extensiva. La densidad de población en esta zona es mayor (35 habitantes por kilómetro cuadrado) con más población joven (la media de edad es de 41 años) y la condición socioeconómica es intermedia entre las otras dos zonas.

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Capítulo 3 Métodos



La investigación en Ciencias de la Sostenibilidad requiere, tal y como se ha mencionado en la Introducción, de la interacción entre disciplinas, lo que se ve reflejado en la aplicación de aproximaciones metodológicas diversas y la combinación de análisis cuantitativos y cualitativos. Los métodos empleados son de uso habitual en las Ciencias Sociales, especialmente en Antropología y Sociología, aunque su aplicación es cada vez más habitual en Ecología. Si bien en cada uno de los capítulos de resultados se presentan los métodos concretos correspondientes, a continuación se presenta una síntesis del conjunto del trabajo desde el punto de vista metodológico (Tabla 3.1).

Tabla 3.1. Síntesis de métodos y herramientas y análisis empleados en el desarrollo de la investigación.

CAPÍTULOS DE RESULTADOS	MÉTODOS/HERRAMIENTAS APLICADAS						ANÁLISIS	
	Revisión bibliográfica	Observación participante	Entrevistas semi-estructuradas	Cuestionarios	Grupos focales	Talleres	Cualitativos	Cuantitativos
4.1								
4.2								
4.3								
4.4								
4.5								
4.6								
4.7								

Las **revisiones bibliográficas** han procurado abarcar cada uno de los temas abordados a lo largo de la tesis, tanto desde el punto de vista teórico y epistemológico, como desde las diversas aristas del socioecosistema objeto de estudio, y en algunos casos, las propias herramientas de análisis. En el caso del capítulo 4.1, la revisión bibliográfica fue sistemática y constituyó además la principal herramienta de obtención de datos. En concreto los temas explorados mediante las revisiones bibliográficas exhaustivas han sido los siguientes:

- Ciencias de la Sostenibilidad
- Servicios de los ecosistemas, especialmente en la cuenca mediterránea
- Valoración de servicios de los ecosistemas y especialmente valoración socio-cultural

- Resiliencia socio-ecológica y capacidad adaptativa
- Ecología de los agroecosistemas mediterráneos
- Ganadería extensiva (o pastoralismo), nomadismo, trashumancia, transterminancia y movimientos de ganado en general, en el mundo, en la cuenca mediterránea y en España
- Conocimiento ecológico local/tradicional y ganadería
- Diseño participativo de escenarios de futuro

El **trabajo de campo**[11] (capítulos 4.2 a 4.7) tuvo lugar principalmente desde febrero de 2009 a octubre de 2011, (aunque hasta el momento de la presentación de esta memoria se ha mantenido el contacto con los ganaderos y ganaderas) dividido en:

- tres *estancias* de cuatro meses (no continuos, con pausas de entre 5-10 días cada 2-3 semanas) conviviendo con pastores trashumantes en Guadalaviar (Teruel),
- un *viaje de trashumancia* entero, de 31 días, en otoño de 2009,
- 25 *salidas de campo*, de 2-7 días de duración, durante 8 trashumancias (entre primavera de 2009 y otoño de 2012),
- dos *campañas de muestreo mediante entrevistas*,
- tres *campañas de muestreo mediante cuestionarios* (la tercera de ellas, relativa al capítulo 4.4 fue realizada por un equipo de estudiantes de grado y posgrado colaboradores),
- una salida de campo para la realización del *grupo focal*,
- una semana de trabajo de campo para la *preparación y realización* de uno de los *talleres*.

[11] Entendido según Guasch (1997) como "el conjunto de técnicas necesarias para obtener la información empírica necesaria, entre las que destaca la observación participante."

Durante este trabajo de campo tuvo lugar la **observación participante**, la herramienta cualitativa de investigación antropológica por excelencia, recogida dentro del conjunto de métodos etnográficos (Taylor y Bogdan, 1987), a través de la cual la investigadora comparte con los investigados su contexto, experiencia y vida cotidiana, con el objetivo de conocer directamente toda la información que poseen los sujetos de estudio sobre su propia realidad (Schensul, et al., 1999). Este método provee el contexto para obtener información imprescindible para desarrollar guías de entrevistas (DeWalt y DeWalt, 2002) y cuestionarios, así como para el análisis crítico de los resultados y la elaboración de la discusión final.

Durante el trabajo de campo se realizaron dos campañas de **entrevistas semi-estructuradas en profundidad.** La primera campaña (*N* = 58) fue relativa al diagnóstico y conocimiento de la trashumancia en la Cañada Real Conquense con vistas a la identificación de los servicios generados por los ecosistemas vinculados a la misma, así como los factores condicionantes del futuro (capítulos 4.2, 4.3, 4.4, 4.5 y 4.7), y la segunda (*N* = 11) correspondió a la identificación y descripción del conocimiento ecológico tradicional de los ganaderos trashumantes (capítulo 4.6). En el caso de la primera campaña las entrevistas estuvieron distribuidas tanto en las áreas de agostada e invernada como en los municipios por los que pasa la cañada, con informantes representativos de cada uno de los grupos de actores clave identificados en visitas preliminares y en un primer taller de expertos, seleccionados bien por resultar clave o bien a través de un muestreo en bola de nieve (Bernard, 2005). En el caso de la segunda campaña, el ámbito de muestreo fue la zona de agostada y las personas entrevistadas fueron informantes clave, ganaderos y ganaderas trashumantes o ex-trashumantes, previamente identificados por su especial conocimiento de la práctica.

Gracias a estas entrevistas, se obtuvo un conocimiento más profundo de la zona de estudio y de la trashumancia, así como la información necesaria para diseñar los tres muestreos mediante **cuestionarios** (*N total* = 880) aplicados en la valoración socio-cultural de los servicios mediante preferencias sociales (capítulo 4.3, Apéndices A y B), en la valoración socio-cultural de los servicios mediante percepciones visuales (capítulo 4.4, Apéndices C y D) y en la evaluación del conocimiento ecológico tradicional (capítulo 4.6, Apéndice E). El uso de cuestionarios para evaluar la demanda social de servicios de los ecosistemas así como su vulnerabilidad es una técnica recientemente aplicada en la investigación científica (ej., Agbenyega et al., 2009; Zhen et al., 2010; Lamarque et al., 2011; Calvet-Mir et al., 2012; Martín-López et al., 2012). Los cuestionarios se realizaron cara a cara, en las tres zonas (agostada, cañada e invernada) en el caso de los capítulos 4.3 y 4.4, y en la zona de agostada para el capítulo 4.6. Parte de la información empleada en el capítulo 4.7 fue asimismo obtenida a través del mismo cuestionario empleado en el capítulo 4.3.

En el marco del trabajo del capítulo 4.6 se realizó un **grupo focal** con algunos de los informantes clave para explorar la diversidad y la convergencia de elementos del conocimiento ecológico tradicional, como parte de la fase previa de construcción del correspondiente cuestionario. Esta herramienta ha sido utilizada en estudios previos similares (Gómez-Baggethun et al., 2010).

A lo largo de la investigación se realizaron asimismo dos **talleres**. El primero de ellos fue un taller de expertos en la Universidad Autónoma de Madrid, en el que se realizó la identificación y caracterización preliminar de actores sociales y servicios generados por los ecosistemas vinculados a la trashumancia. El segundo de ellos fue un taller de dos días de duración con actores sociales representativos de todos los grupos identificados, en el que se desarrolló un diseño participativo de escenarios de futuro (capítulo 4.7).

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Capítulo 4 Resultados

Capítulo 4.1

Explorando el paisaje de conocimiento acerca de los servicios generados por los agroecosistemas de la cuenca mediterránea.

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4.1. Exploring the knowledge landscape of ecosystem services delivered by agroecosystems: insights for future research.

Abstract Ecosystem service assessment has recently become one of the most important scientific frameworks to address the challenges inherent in environmental management, particularly those in agroecosystem management. Agroecosystems provide important ecosystem services to society, including provisioning, regulating, and cultural services. However, the Mediterranean Basin agroecosystems have suffered the effects of two drivers of change, rural abandonment and intensification of agrarian practices, which threaten multifunctional landscapes, and erode the capacity to deliver ecosystem services. In this study, we explored the knowledge landscape of ecosystem services research throughout the Mediterranean Basin's agroecosystems through a systematic review of 165 publications. We (1) analyzed the current research state and trends; (2) examined the existing research gaps and biases; and (3) evaluated interactions among factors related to the methodologies employed, the ecosystem services analyzed, and agroecosystem characteristics. Our results indicated that monetary approaches and provisioning ecosystem services are attracting most of the scientific attention, possibly jeopardizing the regulating and cultural services provided by these ecosystems. Results suggested this invisibility might be related to the absence of integrated approaches that consider the three dimensions of sustainability, i.e. biophysical, socio-cultural, and monetary. Most studies did not use primary data or involve stakeholders in the assessments, and scarce evidence was available regarding ecosystem services provided under different management alternatives. We argue these gaps might have potential implications in current scientific and political debates, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, and the Common Agricultural Policy reform. We therefore provide recommendations for research and policy-making agendas.

Keywords: agroecosystems management; ecosystem services assessment; environmental policy; literature review; integrated approaches, science policy.

Highlights

- Provisioning services are attracting much of scientific attention.
- Regulating and cultural ecosystem services are mainly studied in extensive areas.
- Integrated methodologies have scarcely been used.
- Synergies and trade-offs between different ecosystem services are barely explored.
- Most of the studies do not involve stakeholders in their assessments.

4.1.1. Introduction

The Millennium Ecosystem Assessment (MA, 2005) advanced the scientific community's interest in ecosystem services at the environmental science and policy levels (Fisher et al., 2009; Vihervaara et al., 2010). The assessment of ecosystem services, i.e. direct or indirect contributions of ecosystems to human well-being (TEEB, 2010) aim to provide useful knowledge for policies, strategies, and management of ecosystems to stakeholders (Cowling et al., 2008). However, despite academic progress, many important issues are yet to be resolved in order to fully incorporate the ecosystem service framework on environmental policy targets (Anton et al., 2010; Burkhard et al., 2010; de Groot et al., 2010a; Seppelt et al., 2011).

Three approaches have been identified in the literature to evaluate ecosystem services: biophysical, socio-cultural, and monetary (Cowling et al., 2008; de Groot et al., 2010a). However, a significant number of studies have focused on biophysical and monetary approaches (Vihervaara et al., 2010), ignoring that social factors are often the primary determinants of success or failure of ecosystem services management strategies. On the other hand, appropriate methods to identify and quantify ecosystem service bundles, suitable models, and reliable indicators are still required (Feld et al., 2009; de Groot et al., 2010a; Seppelt et al., 2011).

Despite these knowledge gaps, the ecosystem service framework has unimagined potential to provide informed decision-making by generating evidence-based knowledge derived from multi-functional agroecosystems, and subsequently face the challenge of ensuring sustainability (Swinton et al., 2007). Agroecosystems are managed ecosystems, and therefore provide and rely on important ecosystem services. These services include provisioning services, such as food and fibers; regulating services, such as biological control and pollination; and cultural services, such as recreational activities and ecotourism, spiritual values, and cultural identity (Zhang et al., 2007; Sandhu et al., 2010; Harrison et al., 2010). However, particularly since the Green Revolution, agroecosystems have focused on a single provisioning ecosystem service, frequently food or timber, which has eroded their capacity to deliver a diverse flow of ecosystem services (Gordon et al., 2010). Robertson and Swinton (2005) indicated that active management for multiple ecosystem services might substantially reduce agriculture's environmental footprint.

Of particular interest are threats to the Mediterranean Basin. Ecosystem services delivered by the region's agroecosystems have suffered deterioration primarily due to the impacts of two drivers of change: rural abandonment of mountainous and less productive areas, and land-use intensification of fertile areas (Caraveli, 2000; García-Llorente et al., 2012). Both trends are jeopardizing the Mediterranean multifunctional landscape, which originated from historical co-evolution of human societies and the natural environment (Blondel, 2006; Cuttelod et al., 2008), endangering the high biodiversity of the Mediterranean Basin (Zamora et al., 2007).

Efforts needed to reverse these trends include generating knowledge regarding the ecosystem services provided by agroecosystems, and the impacts of different management strategies on these services (Robertson and Swinton, 2005). Nevertheless, few studies on ecosystem services are conducted in agroecosystems (Feld et al., 2009; Vihervaara et al., 2010), and research is biased towards specific regions, with the gaps in knowledge found in certain Mediterranean countries, particularly northern Africa and Eastern Europe (Seppelt et al., 2011). References to gaps and trends in ecosystem services at a global scale are present in the scientific literature (i.e. Vihervaara et al., 2010; Seppelt et al., 2011), however to date a quantitative and comprehensive evaluation of the knowledge landscape has not been carried out in terms of ecosystem services delivered by agroecosystems, specifically for the Mediterranean Basin.

In the present study, we performed a systematic literature review to explore the knowledge landscape targeting the ecosystem services assessment delivered by agroecosystems in the Mediterranean Basin. Given the potential breadth of this review, we stated the general objective as follows: (1) to analyze historical trends in ecosystem services studies; (2) to explore the geographic distribution of ecosystem services studies; (3) to examine existing biases in the scientific literature related to methodologies, the ecosystem service types analyzed, and the agroecosystem characteristics; and (4) to evaluate potential interactions, and synergies between the factors analyzed, i.e. methodologies, ecosystem services analyzed, and agroecosystem characteristics.

This research will serve to enhance the visibility of Mediterranean agroecosystems as important suppliers of ecosystem services in view of the on-going Common Agricultural Policy (CAP) reform, scheduled for 2014-2020. Furthermore, exposure of scientific literature gaps is necessary to accurately establish economic incentives for farmers who maintain and conserve ecosystem services (European Parliament resolution of 8 July 2010 on the future of the CAP after 2013 (2009/2236 (INI)). Finally, this review will provide insights towards future policy-relevant ecosystem services research, one objective in the agenda of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Perrings et al., 2011).

4.1.2. Methodology

We reviewed scientific publications (i.e. scientific papers, book chapters, conference proceedings, and PhD theses) obtained from the Web of Science, Google Scholar, and Google Web (Google, Inc.) from studies conducted in agroecosystems within the Mediterranean Basin (Myers, et al. 2000). The keywords entered in the review were broad enough to ensure the search included all relevant papers related to ecosystem services delivered by agroecosystems in the Mediterranean Basin (Appendix A), and the search was applied in five languages (English, Spanish, French, Portuguese, and Italian) to smooth, as much as possible, any language bias. Appendix A shows the detailed methodology used in data collection, and Appendix B provides the list of ecosystem services investigated in this research.

We performed an in-depth analysis of each article's content to select only studies that suitably matched the subject of this research, and eliminated studies where the results were covered by another publication included in our database, therefore data was not double-counted in the analysis. Finally, of the 257 publications identified, 164 were incorporated in the review analysis (Appendix C). We subsequently classified each publication (Table 4.1.1) on the basis of its characteristics (i.e. type, language, purpose, year of publication, discipline of the first-author's institution, and discipline of the publication institution), the study location, the methodological approach performed (i.e. ecosystem service assessment approach, data source, system border definition, stakeholder involvement, scenario analysis, management alternatives analysis, and number of ecosystem services assessed), agroecosystem characteristics (i.e. agroecosystem, agrarian practice, productive management type, protected area, Less Favored Area, and operating drivers of change), and category of ecosystem services evaluated (i.e. provisioning, regulating, cultural, or mixed). Details regarding the variables measured are provided in Appendix D.

Table 4.1.1. List of variables considered in this research, and the corresponding attributes.

Variables	Attributes
Publication characteristics	
Type of publication	Scientific papers, Book chapters, Conference proceedings, PhD dissertations
Language of publication	English, Spanish, French, Portuguese, Italian
Purpose of publication	Expansion of site-specific knowledge, Methodological, Management
Year of publication	
Discipline of the first-author's institution	Economics, Environmental Sciences, Agronomic or Forestry Engineering, Civil Engineering, Social Sciences
Discipline of the publication institution	Economics, Environmental Sciences, Agronomic or Forestry Engineering, Social Sciences, Interdisciplinar, Others
Location	
Location of the study area	Countries
Country's GDP (2010)*	
Methodological approach	
Approach of assessment	Biophysical, Socio-cultural, Monetary, Mixed approaches
Data source	Primary, Secondary, Mixed
System border definition	Administrative, Biophysical
Stakeholders involvement	Yes, No
Scenario analysis	Yes, No
Analysis of management alternatives	None, Cost-benefit Analysis, Multi-criteria Analysis
Number of services assessed	
Characteristics of the agroecosystems	
Type of agroecosystem	Ecosystem dominated by woody elements, Grassland, Monospecific herbaceous crops, Multi-crop, Industrial Agriculture
Type of agrarian practice	Agriculture, Livestock, Mixed
Type of productive management	Intensive, Extensive, Organic
Protected area	Yes, No
Less Favoured Area (LFA)	Yes, No
Drivers of change	Direct, Indirect, Both, None
Ecosystem services	
Category of ecosystem services	Provisioning, Regulating, Cultural, Group of ecosystem services

* GDP data extracted from the World Bank (WB, 2010).

We carried out Chi-square tests to explore any significant interactions between the ecosystem services assessment identified in the study, i.e. biophysical, socio-cultural, monetary, and when appropriate, mixed approaches (Appendix E), and the ecosystem services category, i.e. provisioning, regulating, and cultural. We subsequently explored the relationship between ecosystem services categories and other methodological characteristics, i.e. data source and stakeholder involvement, and the agroecosystem characteristics, i.e. type of agroecosystem, type of agrarian practice, type of productive management, protected area, and Less Favored Area. Finally, we applied a Spearman's rank correlation test to analyze relationships between the number of studies conducted in each country, and Gross Domestic Product (GDP); and the relationship between evenness among the three ecosystem service categories assessed in each country, and the countries' GDP. We used Pielou's evenness index, which is typically employed in population ecology to measure species evenness within a community (Pielou, 1977; Priego-Santander et al., 2004).

4.1.3. Results

4.1.3.1.Sample characteristics

Results indicated most studies were papers published in peer-reviewed journals (69%), followed by conference proceedings (19%), book chapters (10%), and PhD dissertations (2%) (Fig. 4.1.1a). Among the publications, 62% were written in English, followed by Spanish and Italian, which comprised 25% and 10% of the studies, respectively (Fig. 4.1.1b). The leading authors in 46% of publications were economists, and forestry or agronomy engineers, and environmental researchers equally conducted 26% of the studies. The remaining publications represented civil engineers and social scientists, however the percentage was almost negligible at 1% each (Fig. 4.1.1c). Institutions specializing in agronomic or forest engineering conducted 34% of the studies, and 32% specialized in environmental sciences. Results also determined 12% of the studies were conducted by interdisciplinary entities. Our results showed a scarce number of social institutions with publications related to this topic (1%), which likely reflects a weak interest in the social sciences (except for economics) in ecosystem service research (Fig. 4.1.1d).

The objectives of the existing scientific information were to expand knowledge of the conditions and trends in ecosystem services delivered by agroecosystems in the Mediterranean Basin, i.e. site-specific (66%), while only 13% were intended to propose management measures (Fig. 4.1.1e).

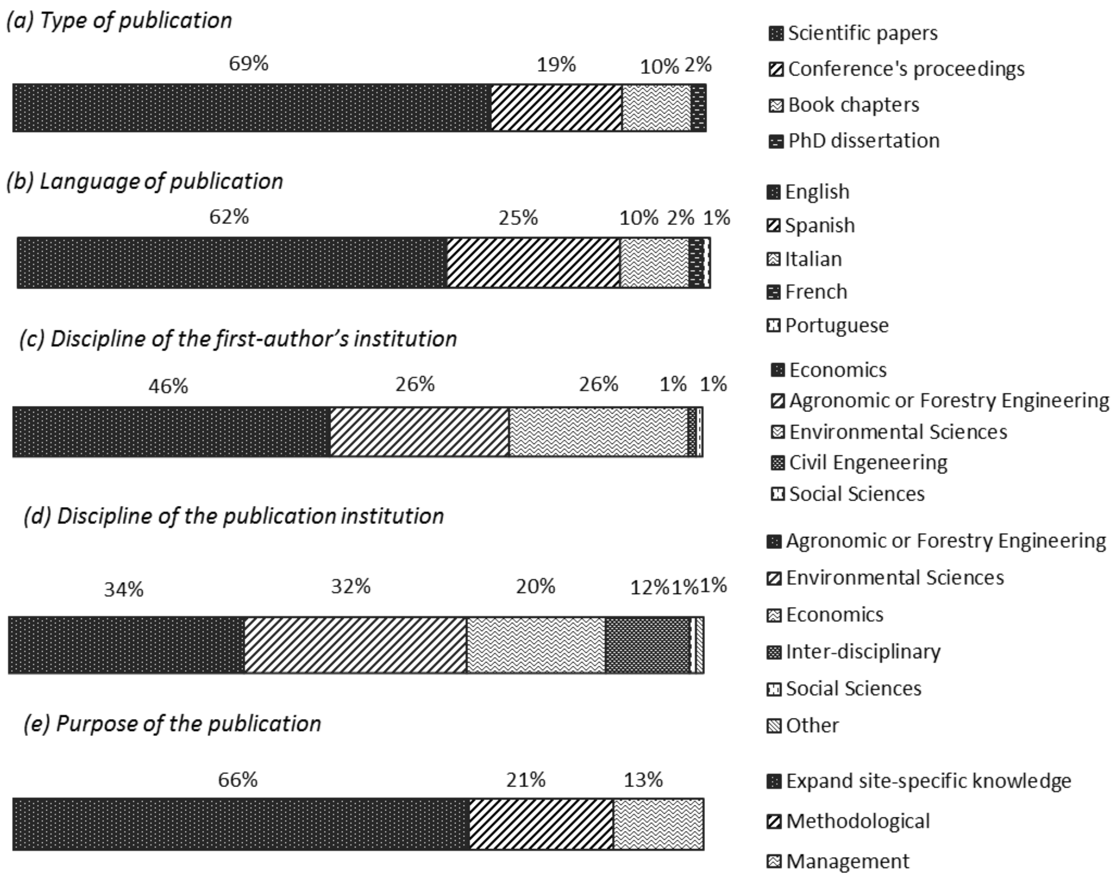
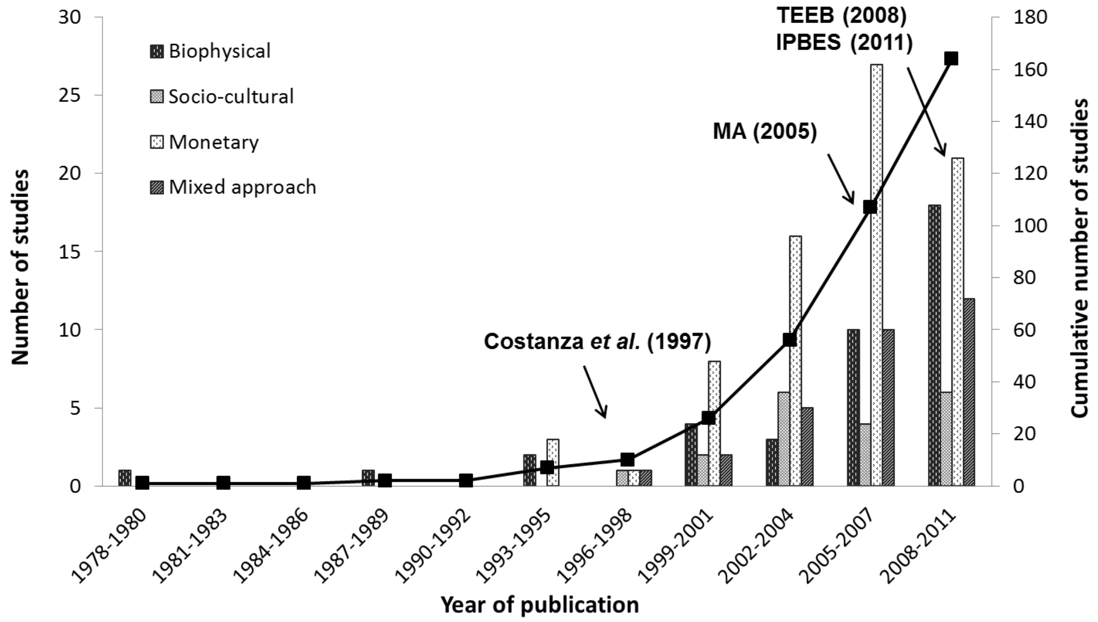


Figure 4.1.1. Percentage of studies belonging to different publication characteristics' categories.

4.1.3.2. Historical trends and geographical distribution of studies

The study set analyzed was published between 1978 and 2011, however only 10 records were published before 1998. The volume of research on this topic shows an increase following Costanza et al. (1997), a paper addressing the value of the world's ecosystem services. Our results suggested this research favored monetary valuation studies from the time of its publication to present (Fig. 4.1.2). The Millennium Ecosystem Assessment (MA, 2005) lead to increased scientific interest in ecosystem services, and our results showed more than 100 publications (65%) published since 2005. Finally, The Economics of Ecosystems and Biodiversity (TEEB), and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) projects have also likely fostered an increase in ecosystem service research (Fig. 4.1.2).



Note. The last time interval includes publications until December 2011, when the review took place, therefore it is twelve months loger than the rest of intervals.

Figure 4.1.2. Historical trend of scientific literature about ecosystem services assessment in Mediterranean Basin's agroecosystems. The methodology of the assessments –i.e., biophysical, socio-cultural, monetary and mixed approaches (using more than one single approach within a study)– is specified. Notice that the last time interval includes publications until December 2011, when the review took place, therefore it is 12 months longer than the rest of intervals.

The agroecosystems evaluated in the study set cover 16 of the 22 countries that form the Mediterranean Basin. The assessments primarily focused on ecosystem services delivered by agroecosystems located in the northern Basin, mainly in Spain (N = 81) and Italy (N = 38) (Fig. 4.1.3). In fact, a significant positive correlation between the number of studies conducted in a country and its GDP was detected (Spearman's rho = 0.79; p-value < 0.0001). Additionally, 50% of the countries focused research strictly on provisioning services. Therefore, a geographic bias related to the ecosystem service category under evaluation was found, primarily in southern countries (Fig. 4.1.3). In fact, we identified a significant positive relationship between the Pielou's evenness index for the three service categories assessed in each country and GDP (Spearman's rho = 0.67; p-value < 0.005), indicating that countries with higher GDP tended to investigate a more diverse ecosystem service set.

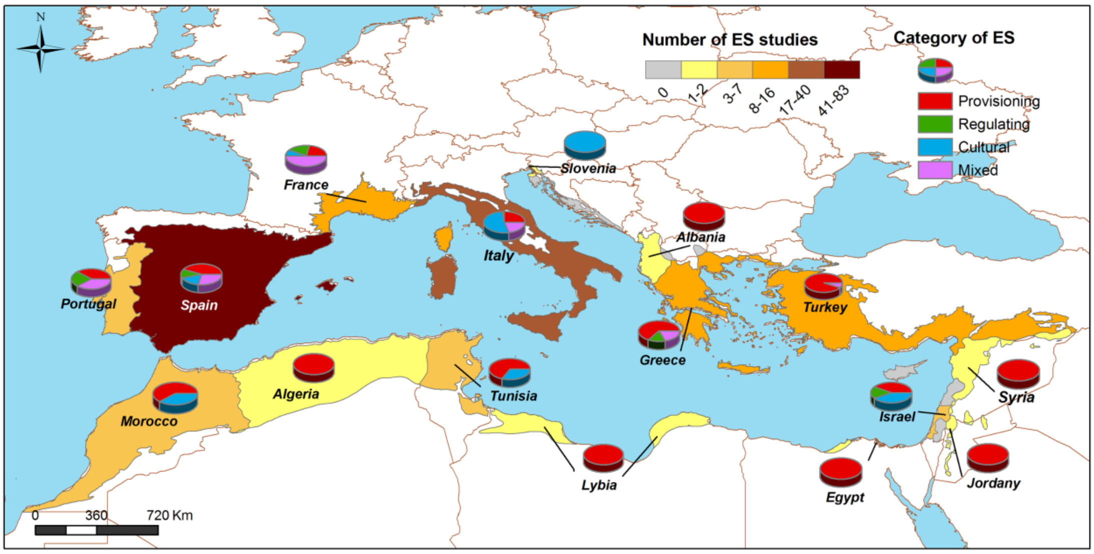


Figure 4.1.3. Geographical distribution of ecosystem services scientific studies carried out in the agroecosystems of the Mediterranean Basin.

4.1.3.3. Methodological approaches in the literature reviewed

The methodology most widely applied in ecosystem services assessments for Mediterranean agroecosystems was the monetary valuation (46% of the total studies), followed by biophysical approaches (24%). Twelve percent of the studies applied a socio-cultural and 18% a mixed approach, using at least two of the above methods (Fig. 4.1.4a). Among the mixed assessments, 90% integrated two types, and 27% of these combined biophysical and the socio-cultural methodologies. The majority of mixed assessments combined a socio-cultural or biophysical approach with economic valuation. The historical trend showed that during the last decade, ecosystem service research primarily used biophysical and monetary valuation methods (Fig. 4.1.2), while the socio-cultural and mixed methodological approaches increased over the entire publication period (Fig. 4.1.2).

Results of 51% of all studies were derived from primary data sources. The remaining 49% reported using secondary sources from official databases (29%), and mixed sources for data compilation (19%) (Fig. 4.1.4b). In addition, more than half the reviewed studies (59%) did not involve stakeholders in the analysis (Fig. 4.1.4c). Most studies defined the study area on the basis of administrative or political boundaries (68%), and the other 32% of the studies were delimited by ecological or biophysical factors (Fig. 4.1.4d). One quarter of the reviewed studies (24%) considered future scenarios in ecosystem service assessment (Fig. 4.1.4e). In addition, 12% evaluated management alternatives, where cost-benefit analysis was the prevailing technique (10%) (Fig. 4.1.4f).

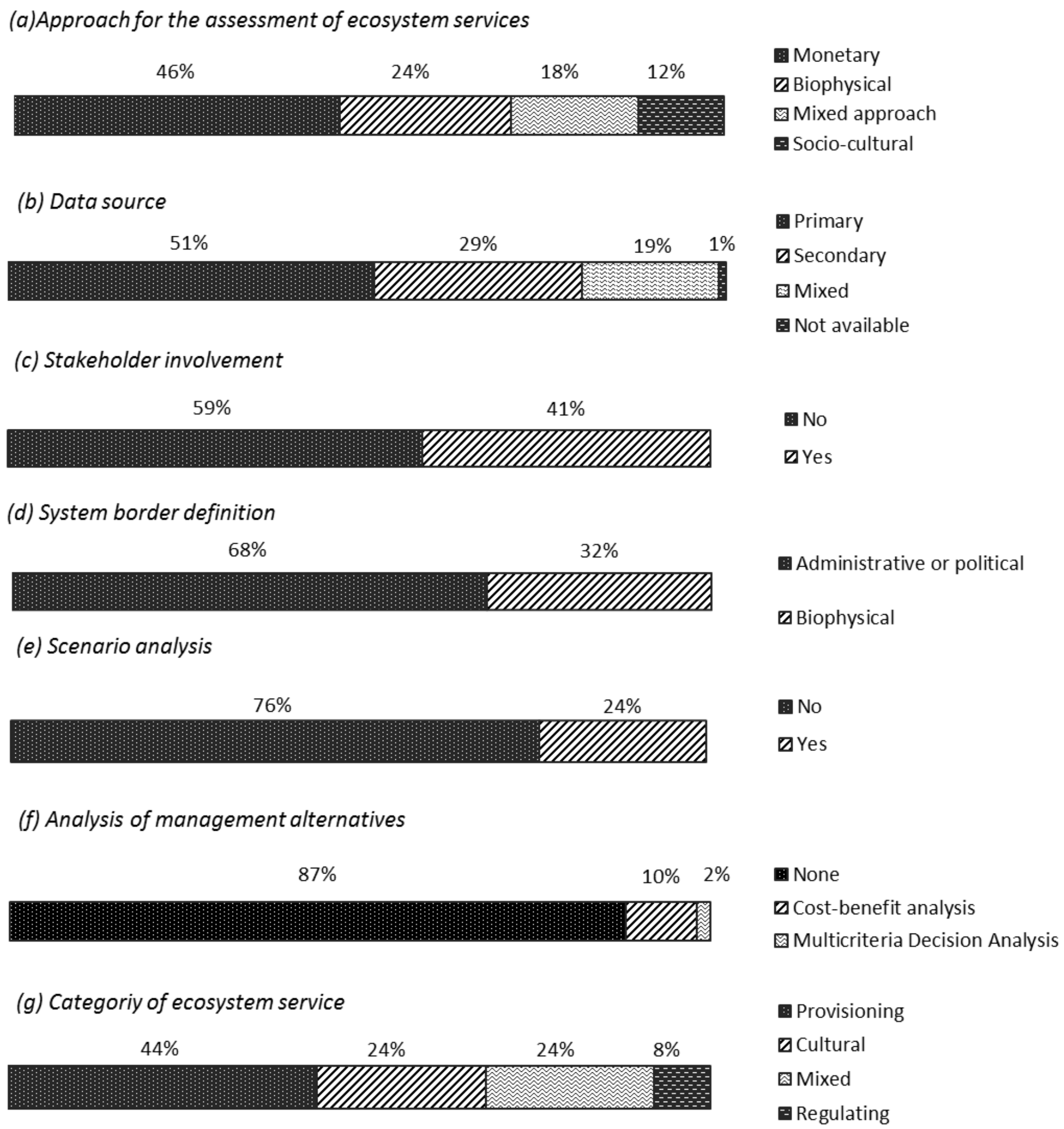


Figure 4.1.4. Percentage of the studies belonging to different categories of methodological considerations (a-f) and ecosystem services typologies (g).

Results for the type of ecosystem service indicated studies focused primarily on provisioning services (44%), and research showed little interest in regulating services (8%) (Fig. 4.1.4g). More than 60% of the studies evaluated only a single service (Fig. 4.1.5). Within this general trend, monetary valuations analyzed five or fewer ecosystem services in the same study, and socio-cultural assessments were largely applied to studies investigating only one ecosystem service. Finally, the studies that assessed more than ten services applied exclusively biophysical or socio-cultural methodologies (Fig. 4.1.5).

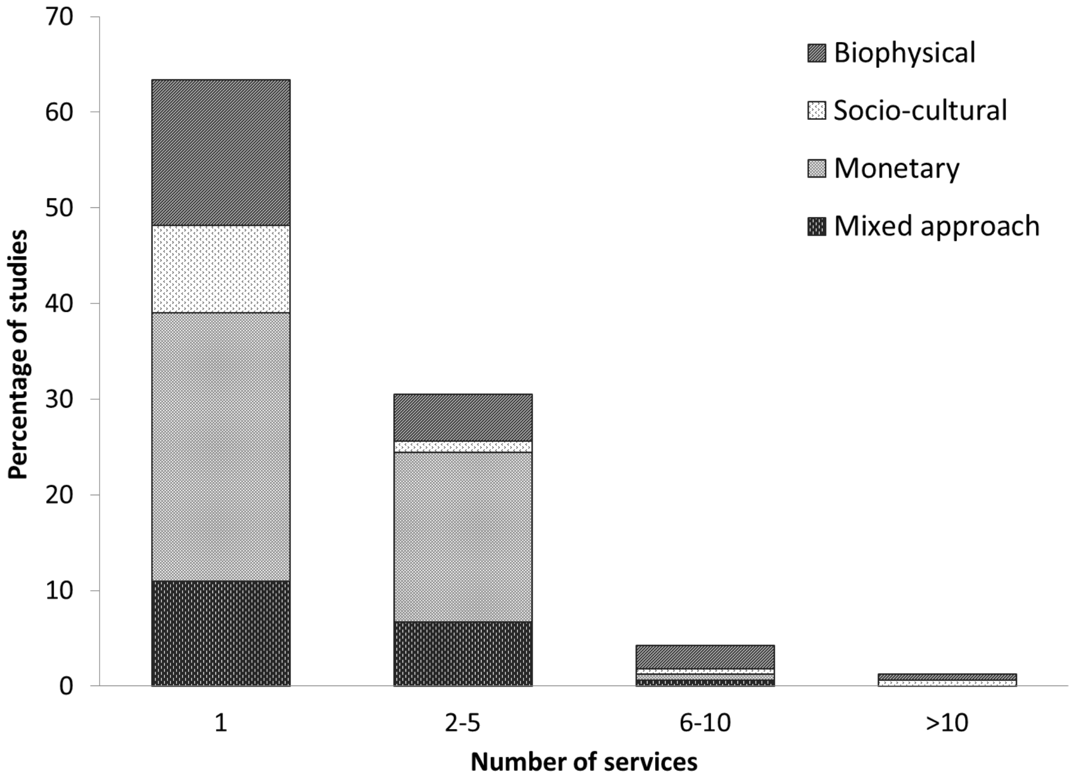


Figure 4.1.5. Percentage of studies according to the number of ecosystem services analyzed. The methodology of the assessments –i.e., biophysical, socio-cultural, monetary and mixed approaches (using more than one single dimension within a study)– is specified.

4.1.3.4. Types and characteristics of agroecosystems

Studies of ecosystem services delivered by agroecosystems in the Mediterranean Basin were developed in ecosystems primarily dominated by woody elements (41%), followed by grasslands (16%), and multi-crop systems (15%) (Fig. 4.1.6a). Research focused on agroecosystems with agricultural (44%) or mixed use (32%), where agriculture and livestock raising co-occurred in the same agroecosystem (Fig. 4.1.6b). The dominant productive management type in the ecosystems analyzed was extensive farming (61%), in contrast with intensive (18%) and organic (8%) farming management (Fig. 4.1.6c). Furthermore, 59% of the agroecosystems were located within protected areas, while 72% were within Less Favored Areas (Fig. 4.1.6d, 4.1.6e). Finally, direct drivers of change strictly threatened nearly half the agroecosystems (47%) and both direct and indirect drivers of change influenced 32% (Fig. 4.1.6f).

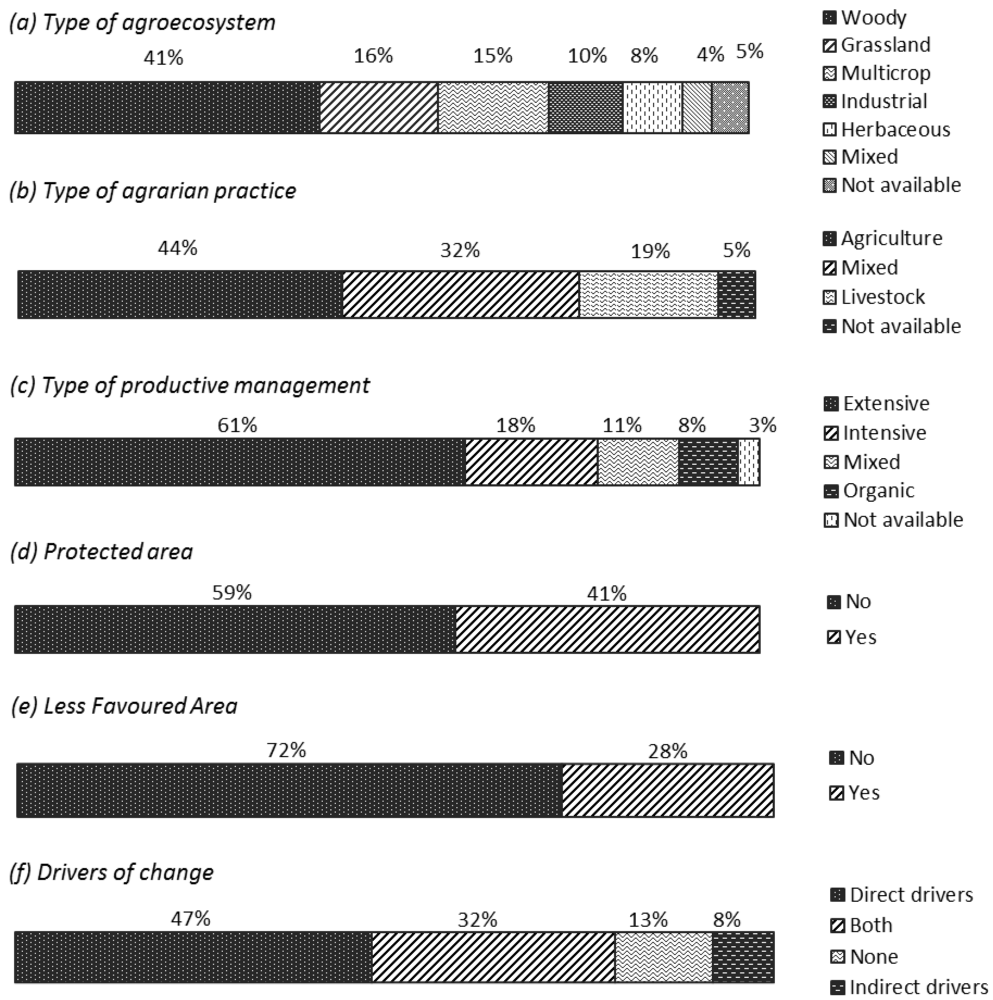


Figure 4.1.6. Percentage of the studies that belong to the specific factor analyzed of agroecosystems' characteristics.

4.1.3.5. Interactions between the variables characterizing the scientific literature

Several significant interactions were detected between the method applied in the reviewed study, and the type of ecosystem service (Table 4.1.2). A significant relationship between the methodological approach (i.e. biophysical, socio-cultural, or monetary), and the type of the ecosystem service was revealed (χ^2 = 34.03; p-value < 0.0001): regulating services were most often assessed through biophysical analysis, whereas cultural services were most commonly evaluated using socio-cultural approaches.

Table 4.1.2. Relationships between methodological factors - i.e., data source and stakeholder involvement- and the methodological approach used in each study -i.e., biophysical, socio-cultural, and monetary- as well as the category of ecosystem services -i.e., provisioning, regulating, cultural and group of ecosystem services (different types of ecosystem services assessed through a single indicator or measure)- on the basis of χ^2 statistics of contingency tables. Numbers of each cell show the observed percentage of studies in each category.

		Category of ecosystem service				**Approach for the assessment of ecosystem services**		
		Provisioning	**Regulating**	**Cultural**	**Group of ES**	**Biophysical**	**Socio-cultural**	**Monetary**
Approach for the assessment of ecosystem services	Biophysical	54.12	25.88*	17.65	2.35			
	Socio-cultural	22.45	12.24	61.22*	4.08		–	
	Monetary	52.80	10.40	33.60	3.20			
Observed association		$N = 259$; $\chi^2 = 34.03$; p-value < 0.0001						
Data source	Primary	40.00	16.43	40.00	3.57	26.43	29.28*	44.29
	Secondary	56.00	14.67	25.33	4.00	32.00	2.67	65.33*
	Mixed	55.81	16.28	27.91	0.00	53.48*	13.95	32.56
Observed association		$N = 259$; $\chi^2 = 8.80$; p-value = 0.185				$N = 259$; $\chi^2 = 33.47$; p-value < 0.0001		
Stakeholder involvement	Yes	38.84	17.36	42.14*	1.65	23.14	28.93*	47.93
	No	55.07*	14.49	26.09	4.35	41.30*	10.14	48.55
Observed association		$N = 259$; $\chi^2 = 10.38$; p-value =0.016				$N = 259$; $\chi^2 = 18.51$; p-value < 0.0001		

* Positive and significant associations at p-value < 0.05

Our results also showed a significant association between the procedural basis, and the data source (i.e. primary, secondary, or mixed) ($\chi^2 = 33.47$; p-value < 0.0001). We found that biophysical assessments usually used mixed data sources (i.e. primary and secondary); socio-cultural evaluations typically applied primary data sources, and monetary valuations secondary data sources (Table 4.1.2). Finally, stakeholder involvement was associated with the ecosystem service category analyzed ($\chi^2 = 10.38$; p-value < 0.05), and the methodology chosen ($\chi^2 = 18.51$; p-value < 0.0001). Cultural service assessments and socio-cultural approaches most often involved stakeholders; however provisioning service and monetary valuation assessments of ecosystem services most often excluded stakeholder participation (Table 4.1.2).

Significant associations between agroecosystem and ecosystem service category (χ^2 = 73.87; *p*-value < 0.0001), and with the specific methodology applied (χ^2 = 99.16; *p*-value < 0.0001) (Table 4.1.3) were observed in the analyses. A comparison of observed distributions from review study data to expected distributions indicated grasslands were largely selected for regulating services studies, industrial agroecosystems were chosen to assess provisioning services, and multi-crop systems were most suitable to evaluate cultural services. Finally, agroecosystems dominated by woody species were largely studied when a group of services, i.e. a set of different ecosystem service categories within an agroecosystem was examined (Table 4.1.3). Similarly, agroecosystems dominated by woody taxa were studied via monetary approaches, grasslands with biophysical procedures, and multi-crop systems using socio-cultural approaches (Table 4.1.3).

Table 4.1.3. Relationships between the characteristics of the studied agroecosystems -i.e., type of agroecosystem, strategy of management, agroecosystem located within a protected area and within a Less Favoured Area- and the methodological approach used in each study -i.e., biophysical, socio-cultural, monetary and mixed methodological approaches (those studies that use at least two of the approaches in the same assessment)- as well as the category of ecosystem services -i.e., provisioning (Prov.), regulating (Reg.), cultural (Cult.), and group of ecosystem services (which considered those studies that analyzed different categories of services)- on the basis of χ^2 statistics of contingency tables. Numbers of each cell show the observed percentage of studies in each category.

		Category of ecosystem service				**Approach for the assessment of ecosystem services**			
		Prov.	**Regul.**	**Cult.**	**Group of ES**	**Biophysical**	**Socio-cultural**	**Monetary**	**Mixed approach**
Type of agro-ecosystem	Herbaceous	44.83	3.45	10.34	41.38	20.69	0.00	27.59	51.72*
	Woody	44.80	6.40	16.00	32.80*	12.80	5.60	54.40*	27.20
	Grassland	46.81	25.53*	12.77	14.89	68.09*	4.26	14.89	12.77
	Multicrop	28.89	4.44	51.11*	15.55*	31.11	26.67*	20.00	22.22
	Industrial	73.33*	3.33	6.67	16.67	26.67	0.00	50.00	23.33
	Mixed	23.08	0.00	53.85	23.08	30.77	7.69	23.08	38.46
Observed association		N = 303; χ^2 = 73.87; p-value < 0.0001				N = 303; χ^2 =99.16; p-value < 0.0001			
Type of productive management	Organic	60.87	0.00	0.00	39.13	28.41*	9.29	42.62	19.67
	Extensive	35.52	12.02*	26.78	25.68	65.22	4.35	8.69*	21.74
	Intensive	64.41	3.39	5.08	27.12	18.64	1.69	30.51	49.15*
Observed association		N = 303; χ^2 = 32.98; p-value < 0.0001				N = 303; χ^2 = 38.38; p-value < 0.0001			
Protected area	Yes	35.61	7.58	21.97	34.84*	15.91	10.61	40.91	32.58*
	No	56.40*	8.14	18.60	16.86	43.02*	4.65	32.56	19.77
Observed association		N = 303; χ^2 = 17.06; p-value = 0.001				N = 303; χ^2 = 27.51; p-value < 0.0001			
Less favoured Area	Yes	30.49	17.07*	35.37*	17.07	47.56*	10.98	23.17	18.29
	No	53.60*	4.50	14.41	27.48	25.23	5.86	40.99*	27.93
Observed association		N = 303; χ^2 = 34.46; p-value < 0.0001				N = 303; χ^2 = 19.18; p-value < 0.0001			

* Positive and significant associations at p-value < 0.05 .

Interactions between variables related to the characteristics of the matrix where the agroecosystem is embedded (i.e. protected areas, and Less Favored Areas), and the ecosystem service categories, revealed more studies related to cultural and regulating services in protected areas, and provisioning service studies were most prevalent in non-protected agroecosystems (χ^2 = 17.06; p-value < 0.001). Similarly, cultural services were of greater interest in Less Favored Areas, and provisioning services were more common outside these areas (χ^2 = 34.46; p-value < 0.0001). Regarding the methods applied to evaluate these interactions, we found that mixed approaches were used in protected areas; while biophysical procedures were preferred outside the protected regions (χ^2 = 27.51; p-value < 0.0001). In Less Favored Areas, the most frequently used evaluation tool was biophysical, while monetary valuations were widely employed outside Less Favored Areas (χ^2 = 19.18; p-value < 0.0001).

Finally, the productive management type was also related to the ecosystem service category (χ^2 = 32.97; p-value < 0.0001), and the methodology (χ^2 = 38.38; p-value < 0.0001). Indeed, our results indicated an unequal distribution in the scientific efforts for evaluating ecosystem services among ecosystem services in intensively and extensively managed agroecosystems (Fig. 4.1.7). In extensively managed agroecosystems, the assessments focused on regulating and cultural services; in intensively managed agroecosystems, attention was placed on provisioning services. Results showed that biophysical methodologies were used in organically managed agroecosystems, and monetary valuation techniques were applied to extensively managed systems (Table 4.1.3).

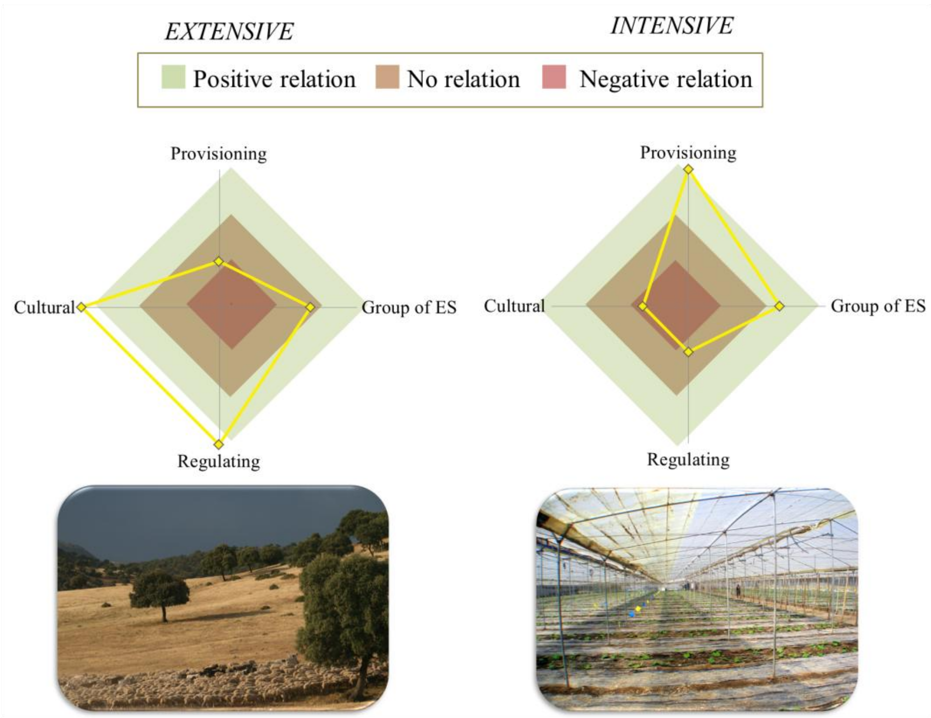


Figure 4.1.7. Relationships between the ecosystem services category -i.e., provisioning, regulating, cultural, or group of ecosystem service (which considered studies that analyzed different services categories)- and the strategy of agroecosystem management -i.e., extensive and intensive-. (ES: ecosystem services).

4.1.4. Discussion

Sustainability concerns for Mediterranean agroecosystems, specifically the capability to provide adequate food for regional inhabitants without jeopardizing cultural and regulating services is increasing within social, scientific, and political communities. The number of publications in ecosystem services provided by Mediterranean agroecosystems has rapidly increased, particularly during the XXI century, following the global development trend in this research area (Fisher et al., 2009; de Groot et al., 2010a; Vihervaara et al., 2010). This trend seems to be fostered by the integration of the ecosystem services framework into global assessments and policy forums (e.g. MA, TEEB, IPBES). Therefore, in the following discussion we provided a panoramic view of ecosystem services research in Mediterranean agroecosystems, guidelines for future research and assessments, and potential implications and insights for policy-making.

4.1.4.1. Caveats of the present review

Although our review was comprehensive within the limits of a systematic search, there were some limitations. First, we recognized that our sample was skewed towards articles published from countries with official romance languages. However, our data showed an increased number of studies in northern countries, and it is possible that an inherent information bias exists towards countries where more resources are available for research development.

Second, we dismissed grey literature to ensure the quality of studies incorporated in our systematic review (Pullin and Stewart, 2006). Notwithstanding these constraints, our review does provide a comprehensive description of the state-of-the-art in ecosystem services research in Mediterranean agroecosystems.

4.1.4.2.Beyond provisioning services: regulating and cultural ecosystem services as a crucial asset of Mediterranean agroecosystems

Vihervaara et al. (2010) reported research on ecosystem services supplied at a global ecosystem level focused mainly on provisioning and regulating services, however in Mediterranean agroecosystems, provisioning services attracted much of the scientific attention, which is consistent with research trends on European agroecosystems (Harrison et al., 2010). Even if agroecosystems have been widely acknowledged as the most important food and fiber suppliers in the world (e.g. Power, 2010), these systems have also been recognized as important regulating and cultural ecosystem service providers (Vandermeer et al., 1998; Robertson and Swinton, 2005; Swinton et al., 2007; Power, 2010; Raudsep*p*-Hearne et al., 2010). Agroecosystems occupy 51% of the European Union land area (MAGEC, 2001), and over one quarter of the global land area (about 5 billion hectares) (Altieri and Koohafkan, 2004), so the importance of these ecosystem types in the delivery of regulating and cultural ecosystem services is without question.

Moreover, the ecosystem services categories analyzed from the review studies were dependent on the productive management of the agroecosystem, i.e. research on provisioning services were linked with intensively managed agroecosystems, while regulating and cultural ecosystem services were primarily studied in extensive and Less Favored Areas' agroecosystems. Finally, a broader ecosystem services range or bundles were studied in agroecosystems within the limits of protected areas. These relationships might serve to enhance a territorial model segregating agroecosystems from protected areas, i.e. natural conservation from food production (García-Llorente et al., 2012; Martín-López et al., 2012), drawing a parallel with the land-sparing concept (Phalan et al., 2011). Instead of promoting the conservation-production dichotomous view, research on agroecosystems should explore different management practices located in the continuum between the two extremes and move towards optimal territorial models, so that an integration of the three sustainability spheres (ecological, social, and economic) in agroecosystem management is ensured. In this way, equilibrium between regulating, cultural, and provisioning services could be better achieved. In other words, without in-depth analyses regarding the trade-offs between different management options, and the corresponding ecosystem services enhanced under each management model, we cannot address the challenges of fulfilling the needs of society (Vigilizzo et al., 2012; Hauck et al., 2013).

4.1.4.3. Comprehensive assessments for better ecosystem services valuation

An ongoing theoretical debate surrounds the commensurability of ecosystem services values, and emphasizes that ecosystem services values are multidimensional, i.e. ecological, social, and economic (e.g., Gómez-Sal and González García, 2007; de Groot et al., 2010b; TEEB, 2010; Turner et al., 2010), and therefore not all can be converted into a unique quantitative measure (Martinez-Alier et al., 1998; Gómez-Baggethun et al., 2010; Kosoy and Corbera, 2010; Peterson et al., 2010). In order to better acknowledge ecosystem services other than provisioning, the bias towards the monetary valuation approach that we found should be corrected.

Despite the recognized necessity to include biophysical, socio-cultural, and monetary approaches into ecosystem service research (Mascia et al., 2003; Cowling et al., 2008; Martín-López et al., 2009; TEEB, 2010), integrated approaches have scarcely been applied. In part, this might be due to the absence of a shared theoretical framework. Ecosystem services have usually been approached from traditionally separated disciplines (Martín-López et al., 2009; Vihervaara et al., 2010), which we observed in the heterogeneous distribution of author disciplines and publication institutions involved in the studies.

Furthermore, we identified certain methodology limitations in current ecosystem services research in Mediterranean agroecosystems. The studies often investigated one single ecosystem service without exploring the synergies and trade-offs between all different ecosystem services. Seppelt et al. (2011) reported the shortcomings of single ecosystem services research, resulting in an existing worldwide knowledge gap in integrative and holistic approaches for the assessment of multiple ecosystem services (Zhang et al., 2007; Bennett et al., 2009; Nicholson et al., 2009; de Groot et al., 2010a; Power, 2010). The fact that ecosystem services are interdependent, and so are service' values can result in double-counting, particularly in biophysical and monetary valuations. This constitutes a challenge already recognized, about which socio-cultural valuation has a lot to say (see section 5.4, Chan et al., 2012b). In addition, research on specific ecosystem services certainly contributes to garner data, and advance knowledge on specific service functioning, but a lack of integration in evaluations within comprehensive ecosystem services assessments might overlook trade-offs and synergies (Laterra et al., 2012; Vigilizzo et al., 2012).

4.1.4.4. Participatory approaches for bridging scientific or technical and local knowledge

Ecosystem services assessments from one methodology, e.g. monetary or biophysical, might be driving the omission of the stakeholder's values and needs towards the ecosystem. In fact, we found that most studies do not involve stakeholders in the evaluation. The ecosystem services concept is inextricably linked to human well-being, so stakeholder involvement and participation in ecosystem services assessments is particularly important (Cowling et al., 2008; Reed, 2008; Ash et al., 2010; Aretano et al., 2013; Hauck et al., 2013).

Since conservation interventions require changes in human behavior to succeed (Mascia et al., 2003), socio-cultural approaches should be considered keystone for ecosystem services assessments (Cowling et al., 2008; Menzel and Teng, 2010; Chan et al., 2012b; Martín-López et al., 2012). Consequently, we argue that the involvement of stakeholders, as well as social scientists in research about ecosystem services supplied by Mediterranean agroecosystems is critical to target regional conservation challenges integral in the well-being of human populations.

4.1.4.5. Integrating scenario planning

Another important component of ecosystem service assessments is to design management alternatives adapted to uncertain future scenarios (Palomo et al., 2011). The provision of ecosystem services delivered by agroecosystems, and the appreciation of their values by society, are subject to a high degree of uncertainty due to the synergistic effects of direct and indirect drivers of change (Johnson et al., 2012). For example, extreme climate events condition ecosystem functioning, e.g. fire hazards are inherent to Mediterranean ecosystems, but extreme fire frequency might alter ecosystem functioning; crop products have volatile prices, e.g. biofuel global market conditions influence cereal prices, affecting food security; and cultural values change with individual and social experiences, e.g. within the current European financial crisis, some young unemployed seem to be reverting the rural abandonment trend of past decades.

Consequently, uncertainty research in agroecosystem services is clearly in a precursory state. The literature is mainly building site-specific knowledge regarding "static" ecosystem service attributes, with few studies developing management alternative analyses, and very few having incorporated scenario analysis to deal with unpredictable futures. If our objective is to preserve agroecosystems' capacity to provide a diverse flow of ecosystem services over the long-term, management should consider their dynamic nature, and integrate the causes and consequences of different drivers of change on agroecosystem, as well as the system's capacity to withstand large impacts without fundamental change (Folke et al., 2002).

4.1.5. Conclusions

A potential opportunity to reverse the diverging intensification and abandonment trends in Mediterranean agroecosystems is to explore intermediate management options that can close the gap between intensive and extensive agroecosystems, and raise public awareness for regulating and cultural services delivered by these ecosystems. More equitable agroecosystem management models can be achieved by evaluating the impacts of different productive management options on the provision of a diverse flow of ecosystem services (Swinton et al., 2007; Bennett et al., 2009; de Groot et al., 2010a; Bommarco et al., 2012).

In the CAP reform proposal for 2014-2020, the European Parliament recognized that the market failed to reward farmers for protecting the environment and other public goods, and claims for a provision of monetary incentives for farmers to optimize the delivery of ecosystem services (European Parliament, 2010). Prior to the last CAP reform academics suggested that investments should be directed to enhancing profitability by means of an increase in product quality and organic agriculture, and the social valuation of other non-provisioning ecosystem services (Gómez-Sal, 2007). Although a current important body of knowledge regarding ecosystem services delivered by Mediterranean agroecosystems has potential to contribute to the design of the new CAP, we observed high asymmetries, e.g. in terms of the ecosystem services evaluated, and the methods applied, that might hinder the incorporation of this knowledge to the reform. In addition, prior to implementing market-based incentives, such as payments for ecosystem services, more research is needed in agroecosystems to address the impact of these incentives in land-use change decision and the effect of land-use change on ecosystem services supply (Bryan 2013).

Alternatively, to establish an efficient IPBES, scientists must serve a role as "early warners" and "identify pertinent topics that unify different stakeholders, and reflect the characteristics of the different regions and scales" (Vohland et al., 2011). Given these considerations, our review indicated strong geographic inequities in the progress of this branch of knowledge, and emphasized the need to expand this research in some regions of the Mediterranean Basin. Furthermore, it identified general challenges in the future of ecosystem services research in Mediterranean agroecosystems.

Consequently, if a major objective of ecosystem services science is to effectively inform the design and implementation of future agrarian policies, scientists should promote a holistic methodological framework that (1) evaluate ecosystem services diversity and trade-offs; (2) embrace the multidimensional nature of values; (3) analyze supply and demand through the use of different approaches, and on the basis of primary data; and (4) consider the inherent uncertainty in agroecosystems by analyzing the effects of different management options on the changing ecological, social, and monetary attributes over time.

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Appendix A. Methods for data collection

We carried out a systematic review following the criteria of Pullin and Stewart (2006). We made use of the keywords (indicated below in English) in four common languages of the Mediterranean Basin (i.e., Spanish, French, Portuguese and Italian), as well as in English, and searched in the Web of Science, Google Scholar and Google Web databases. The keywords used were broad in order to make sure our search covered all relevant publications related to ecosystem services delivered by agroecosystems in the Mediterranean Basin. In addition, authors were contacted by e-mail when the publication was not available in the web.

The keywords used in the search were:

"agro*" OR "agri*" OR "agroecosystem" OR "agrosystem" OR "farm" OR "rural landscape" OR "pasture" OR "livestock" OR "agriculture"

AND

"evaluation" OR "assessment" OR "valu*" OR "economic valuation" OR "econom* valu*" OR "monetary valu*" OR "contingent valuation"

AND

"eco* services" OR "eco* goods" OR "environmental services" OR "services" OR "biodiversity" OR "culture".

AND

"Mediterranean" OR "Mediterranean basin"

The publications' content was reviewed in order to evaluate its convergence with our research subject. This review allowed us to make a deeper research checking over the publications' reference lists looking for new titles that were likely to converge with our sample. Moreover, we made a list of the more recurrent authors, and carried out a new search "*by authors*". The early reference material found by this procedure assembled 257 articles. Finally, only 164 publications were considered in our analysis because they properly matched with the subject and objectives of this research. The list of papers included in our analysis is shown in Appendix C.

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Appendix B. Ecosystem services classification

Based on the TEEB (The Economics of Ecosystems and Biodiversity, 2010) project, we defined ecosystem services as "the direct or indirect contributions of ecosystems to human well-being". The services classification process was guided by the agroecosystem's services list made up by the Millennium Ecosystem Assessment (MA, 2005) and the Millennium Ecosystem Assessment of Spain (EME, 2011) which classified the services in three categories: provisioning, regulating and cultural. We show the ecosystem services' classification applied in this study in Table B1.

Table B1. List of ecosystem services considered in this research and their description.

Ecosystem services	Description and/or examples
Provisioning	
Food	Agriculture or livestock products
Raw materials of biological origin	Wood, pasture, manure, mushrooms, wool, cotton
Fresh water	Water reservoir: ponds for irrigation and cattle ponds
Renewable energies	Firewood, solar or wind farms, energetic crops, biogas from waste
Genetic pool	Agrobiodiversity, autochthonous breeds, wild plants associated with agroecosystems
Natural medicines and active principles	Domestic or wild species, pollen, honey, roots, bark, leafs
Regulating	
Climate regulation	Evapotranspiration, coverage of woody species, carbon sequestration.
Air purification	Soil or wood carbon stock, methane dynamics
Hydrological regulation and water purification	Irrigation systems, deposits and ditches
Erosion control	Erosion control, maintenance of balconies and terraces, built fences and walls, hedges
Soil fertility	Incorporation of organic matter in the soil, composting, rotations, stubble grazing, nitrogen and phosphorus stocks
Natural hazards control	Fires, flood or landslide control
Biological control	Invasive species' spread control and pest control
Pollination and seed dispersal	Maintenance of the crops reproductive function
Cultural	
Scientific knowledge	Technical and scientific documents related to agrarian activities
Local ecological knowledge	Experiential knowledge about agricultural practices or ecological properties
Cultural identity and sense of belonging	Local traditional events, gastronomy and crafts, maintenance of the architectural heritage
Spiritual value	Spiritual values associated to historic events and mythologies or religions, including option, bequest and existence values
Aesthetic value	Aesthetically valuable agrarian and cultural landscapes
Recreation activities and ecotourism	Hunting, fishing, walking in rural paths and livestock routes, rural tourism, sport, hiking, horse-riding or biking
Environmental education	Technical and professional trainings for improving the agrarian practices, school-farms

We found a heterogeneous distribution of the ecosystem services studied throughout the publications. Among the services more studied, food and the aesthetic value stand out above the rest (Figure B1).

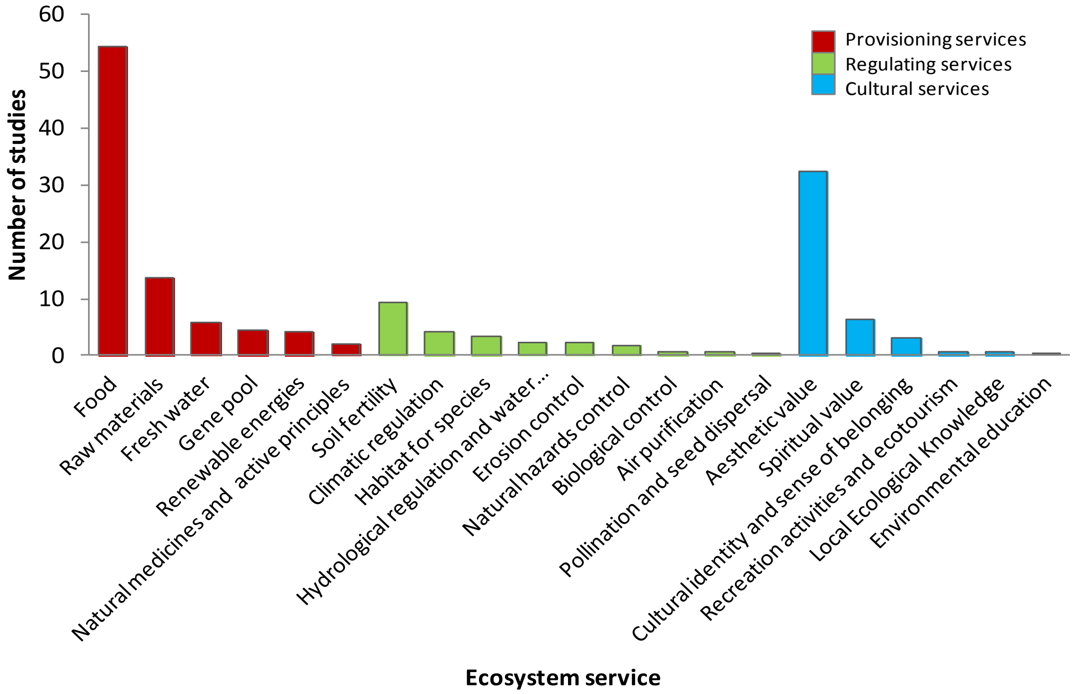

Figure B1. Number of studies that considered each of the ecosystem services analyzed.

See Table B1 above for a list and description of ecosystem services. The number of publications that evaluate a given ecosystem service was “normalized” as done in Seppelt et al. (2011)-i.e., if a publication studied two different ecosystem services, the contribution of each one to the accounting would be 0.5 respectively-.

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Appendix D. Description of variables

Data was collected and classified in a database according to variables related to the publication characteristics, study location, methodology, agroecosystem characteristics, and ecosystem services (Table B1). Below we provide detailed variable specifications from this research.

Publication purpose:

- Three different purposes were identified in the scientific literature reviewed: the purpose to expand site-specific knowledge was designated when the study showed it was adding to a body of information regarding ecosystem services delivered by agroecosystems; methodological purpose referred to studies where the main objective was to develop or explore a methodology to evaluate ecosystem services; and management purpose was ascribed to studies that developed a management strategy in a specific area.

Discipline of the first-author’s institution:

- The first author’s primary research area was specified by this variable based on the institution’s department discipline where the author works. We did not include economists within the social scientist group to verify if there is disparity in the participation of institutions with a focus on economy from other branches of the social sciences.

Discipline of the publication’s institution:

- This variable was based on the self-reported discipline of the journal for scientific papers; the book publisher for book chapters; the web site for online references; and the association or other institution for conference proceedings or PhD dissertations, respectively. Economists were not included within the social scientist group, as in the previous variable. When an institution appeared to be comprised of different disciplines, an interdisciplinary category was applied. Finally, disciplines with a percentage below 1% were assembled in an “others” category.

Ecosystem services assessment approach:

- The scientific literature identifies three approaches for assessing ecosystem services: biophysical, socio-cultural, and monetary (Groot et al., 2002; Cowling et al., 2008; Haines-Young and Potschin, 2009). Biophysical assessments study the key ecological properties underlying the ecosystem service supply, or the delivery level based on biophysical units (Cowling et al., 2008). This type of evaluation is typically conducted using direct biophysical measures, biophysical indicators, expert opinions, and energy and/or emergy analyses. Socio-cultural assessments focus on the preferences, needs, values, norms, and behaviors of individuals, institutions, and organizations towards ecosystem services (Cowling et al. 2008). Finally, the monetary approach assigns a monetary value to ecosystem services by means of a marginal change on supply (Turner et al. 2010) using a variety of techniques, including market prices, and revealed and stated preferences (Chee, 2004; Kaval, 2010; Pascual et al., 2010).

Data sources:

- We defined data sources as the procedure for information collection used in the review studies, which was classified according to Seppelt et al. (2011) as primary (field sampling or surveys) or secondary (official databases, scientific information, atlas data, and expert knowledge). We referred to mixed data when authors used both types of data sources.

Stakeholder involvement:

- Stakeholders were considered involved when residents or institutions in the study area actively participated in the design or development of the scientific research regarding ecosystem services (Seppelt et al., 2011).

System border definition:

- This variable delimited the study area, and we defined the two following levels: administrative borders referred to organizational or political delimitations, e.g. municipalities, or countries; and biophysical borders, which exhibited ecological boundaries, e.g. ecosystems, basins, or eco-regions.

Scenario analysis:

- This variable was examined in assessments where ecosystem services were evaluated under different future scenarios, such as management alternatives or potential future scenarios (Seppelt et al., 2011).

Management alternative analyses:

- The methods identified for management alternative analyses were Cost-benefit Analysis and Multicriteria Decision Analysis. The latter was only considered when a real comparison of alternatives was carried out; however this did not include studies that used this tool for other purposes, such as valuation.

Number of ecosystem services:

- Ecosystem service assessed in each study was done based on our ecosystem service classification (Table B1 in Appendix B), and not on the classification used in each study. For example, if a specific number of food products were individually evaluated in a study, we classified only one single service according to the “food” category.

Agroecosystem types:

- The categories applied in this variable were defined in the Millennium Ecosystem Assessment of Spain (EME, 2011). We consider that the classifications based on Spanish agroecosystems could be extrapolated to the Mediterranean basin agroecosystems as a whole.

Agrarian practice types:

- The level of agroecosystem specialization was evaluated by studying each agrarian practice separately in the three following categories: “agriculture” for agroecosystems where livestock were totally absent; “livestock” for agroecosystems where crops were absent; and “mixed practices”, with agriculture and livestock, a common situation in Mediterranean landscapes.

Productive management types:

- The productive management type applied to the agroecosystem classified (based on author criterion) under three different strategies: organic, extensive, and intensive.

Protected area:

- We verified whether the agroecosystems in the reviewed studies were located within any protected areas recognized by legislation, or government, i.e. National, Natural, and Regional Parks, or Natural Reserves, or within an international or European protected network, i.e. World Network of Biosphere Reserves (Biosphere Reserve Nomination Form, UNESCO, February 2004), Natura 2000 Network (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora), List of Wetlands of International Importance (Convention on Wetlands of International Importance Especially as Waterfowl Habitats; I.L.M. 11:963-976; September 1972), and Protected Geographical Status (Council Regulation (EC) No. 510/2006 of 20 March 2006 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs).

Less Favored Area:

- Less Favored Areas (LFA) were defined by the Council Directive 75/268/EEC of 28 April 1975 for mountain and hill farming, and farming in certain less-favored areas; and the Council Regulation (EC) No. 950/97, 1257/1999, 2603/1999, 445/2002, 1783/2003, and 817/2004 of the European Union, as mountainous areas, with reduced soil fertility, resulting in low agricultural production, and with low population density. An agroecosystem was considered within a LFA when it satisfied these criteria.

Drivers of change:

- Drivers of change were any natural or anthropogenic factors that directly or indirectly caused an ecosystem change (Nelson, 2005). A direct driver unequivocally influenced ecosystem processes, while an indirect driver operated more diffusely, by altering one or more direct drivers (Nelson, 2005). For our purposes, the drivers of change had to be explicitly stated to be included in the analysis. The drivers in each category, and their presence in the sample are shown in Figure B2.

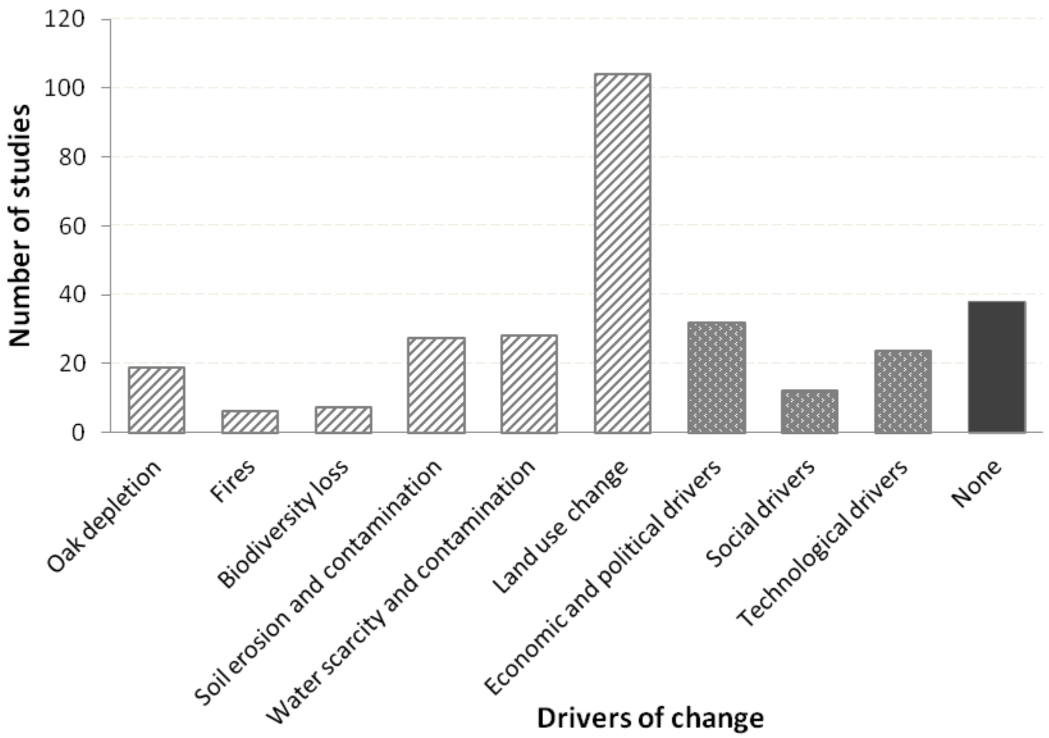

Figure D2. Number of studies that analyzed each driver of change. The number of locations threatened by a given driver of change was transformed as in Seppelt et al. (2011), i.e. if two divers of change threatened an agroecosystem; the contribution of each one to the accounting was 0.5.

Ecosystem service categories:

- We classified ecosystem services into three categories, provisioning, regulating, and cultural following the Millennium Ecosystem Assessment (MA, 2005), and the Millennium Ecosystem Assessment of Spain (EME, 2011). Subsequently, for the "descriptive analysis" (Fig. 4.1.4), we added a mixed category to characterize the studies that assessed different types of ecosystem services. Alternatively, for statistical analyses (Fig. 4.1.7; Tables 4.1.1, 4.1.2) we used ecosystem services groups to illustrate the evaluation of different ecosystem services types under the same methodology and/or the same agroecosystem (see Appendix E).

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Appendix E. Database transformations

The initial database included more than one observation per study according to each of the variables included. This is useful to collect all the information about a specific study, but this process induced the presence of duplicates when dealing with certain variables. For this reason the matrix had to be treated when analyzing the data, according to each of the objectives, and therefore the number of observations varies.

For a better interpretation of the analysis of publications and methodological characteristics (Figures 4.1.1-5 of the main text), we reduced to one the number of observations in a study by means of using mixed categories to compile the information. This was the case of the "ecosystem services mixed category" that joins different types of ecosystem services and the "mixed approaches" category, which refers to the use of more than one type of assessment approach in a study. For the description of the agroecosystems studied (Figure 4.1.6 of the main text), we restricted the number of observations according to the number of different sites (agroecosystems) evaluated (N=298).

The database treatment for the statistical analysis was resolved performing two different database processing, one for the Chi-squared tests that incorporated methodological variables and another for those which incorporated agroecosystems variables. We grouped into the category of "groups of ecosystem services" the assessments of more than one category of ecosystem services under the same methodology or in the same agroecosystem. We also grouped into "mixed approaches", the different assessment carried out in one single agroecosystem (Figure E3).

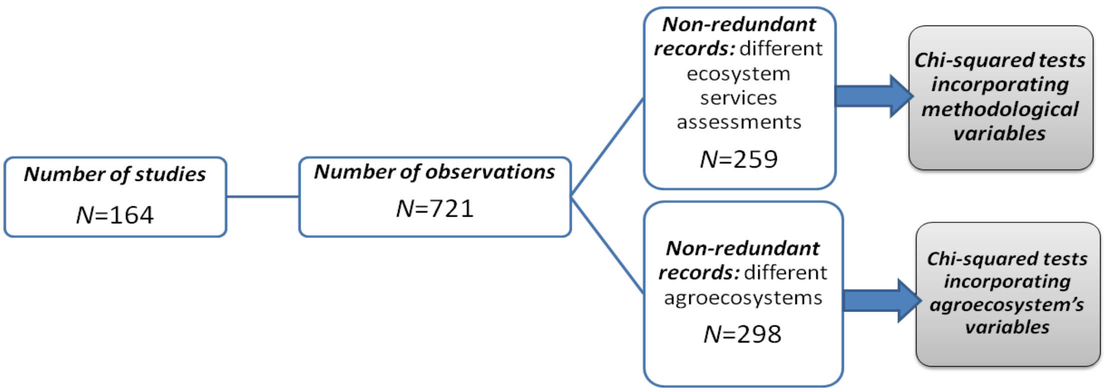

Figure E3. Number of observations (N) obtained in the two different database treatments carried out for the Chi-squared statistical analysis.

Capítulo 4.2

Evaluando los servicios de los ecosistemas en los paisajes culturales de la trashumancia. Un marco interdisciplinar y participativo

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4.2. Evaluating Ecosystem Services in Transhumance Cultural Landscapes. An Interdisciplinary and Participatory Framework

Abstract Following the concept of ecosystem services, we propose in this article an interdisciplinary and participatory methodological framework for ecosystem services assessment and participatory decision-making in Mediterranean cultural landscapes linked with transhumant pastoralism. It is based on four sequential phases: 1. characterisation of the social-ecological network associated with transhumance, 2. preliminary identification and characteri sation of ecosystem services, 3. evaluation of ecosystem services (in biophysical, socio-cultural, and economic terms), and 4. future scenario planning for the analysis of social conflicts related to ecosystem services use and trade-offs as well as the proposal of management strategies. Applying the framework to a case study on one of the major transhumance landscapes in Spain, we could identify and evaluate more than 30 ecosystem services. The framework facilitated the design of robust policy measures that aim to maintain this livestock raising model and its associated flow of ecosystem services. It also contributes to provide the basis for the implementation of adaptive co-management strategies.

Keywords adaptive co-management, Conquense Royal Drove Road (CRDR), decision-making, future scenario planning, social-ecological network.

4.2.1. Introduction

Since the release of the Millennium Ecosystem Assessment (MA 2005), the science of ecosystem services has attracted much attention in the scientific community, as the increasing number of publications in recent years shows (Fisher et al. 2009, de Groot et al. 2010). The concept of ecosystem services, i. e., the direct and indirect contributions of ecosystems to human well-being (TEEB 2010), has become highly relevant in policy-making capturing the attention and interest of a wide range of institutions and decision-makers involved in biodiversity conservation, landscape planning and socioeconomic development.

Ecosystem services evaluation can be particularly useful in cultural landscapes (Schaich et al. 2011), such as the Mediterranean basin, where ecosystems and human societies have coevolved for millennia, producing a unique and characteristic landscape configuration (Makhzoumi and Pungetti 1999). In Mediterranean cultural landscapes, extensive management and traditional landuse practices have left room for highly biologically diverse agroecosystems responsible for the provision of important ecosystem services.

Transhumance, the seasonal migration of livestock between summer pastures in highlands at northern latitudes and winter pastures in lowlands at more southern latitudes, is one of the many customary practices developed by ancient Mediterranean societies to adapt to an unpredictable and highly fluctuating environment (Gómez Sal 2000, Herzog et al. 2005). Matching grazing pressure to seasonal peaks in pasture productivity allows an optimal exploitation of existing resources (Ruiz and Ruiz 1986, Manzano-Baena and Casas 2010).

Transhumance has been acknowledged for its role in habitat conservation, seed dispersal, fire prevention, high quality meat production and cultural identity among other ecosystem services (Bunce et al. 2006). Although the latter are not always directly related to or dependent on livestock movement, the traditional practice is responsible for the conservation of crucial features of the social-ecological system that make the provision of ecosystem services possible.

In this article we present a methodological framework for ecosystem services evaluation, trade-offs analysis, and prioritisation of management strategies, which is particularly designed for transhumance cultural landscapes.We then illustrate its application to the case study of the Conquense Royal Drove Road (CRDR), one of the major Spanish drove roads still in use. In the end, we address the relevance and usefulness of the framework for policymaking and adaptive co-management in Mediterranean cultural landscapes.

4.2.2. Methodological Approach for Ecosystem Services Evaluation in Transhumance Landscapes

In order to develop a conceptual framework for ecosystem services evaluation, we have approached transhumance cultural landscapes as social-ecological networks (sensu Janssen et al. 2006), i. e., as "networks of biophysical and social flows generated and maintained by the movement of herders and livestock," including summering and wintering areas, the network of drove roads linking them and the associated social capital elements (Oteros-Rozas et al. forthcoming).

Our methodological framework is structured into four sequential phases (Fig. 4.2.1):

1. characterisation of the social-ecological network associated with transhumance,
2. preliminary identification and characterisation of ecosystem services,
3. evaluation of ecosystem services (in biophysical, sociocultural and economic terms), and
4. future scenario planning for the analysis of social conflicts related to ecosystem services use and trade-offs as well as the proposal of management strategies.

Two crosscutting issues permeate the entire process: interdisciplinarity and stakeholder participation. Despite its socio-cultural and ecological relevance, transhumance has been traditionally approached only from unidisciplinary perspectives – either ethnological, historical or ecological. However, in order to highlight the importance of livestock movement from ecological, social and economic viewpoints (i.e., different value domains of ecosystem services) (Martín-López et al. 2009, De Groot et al. 2010), an interdisciplinary assessment of ecosystem services is particularly appealing.

It is, moreover, fundamental to develop the whole assessment within a participatory process (Reed 2008), i. e., involving the diverse stakeholders, in order to accurately address the ongoing trade-offs and conflicts among ecosystem services beneficiaries and losers (Harrington et al. 2010). As specific stakeholders involved, transhumant herders as well as academics from different disciplines, environmental and cultural non-governmental organisations committed to the preservation of transhumance, and decision-makers involved in drove road management should be included in the implementation of such a participatory framework.

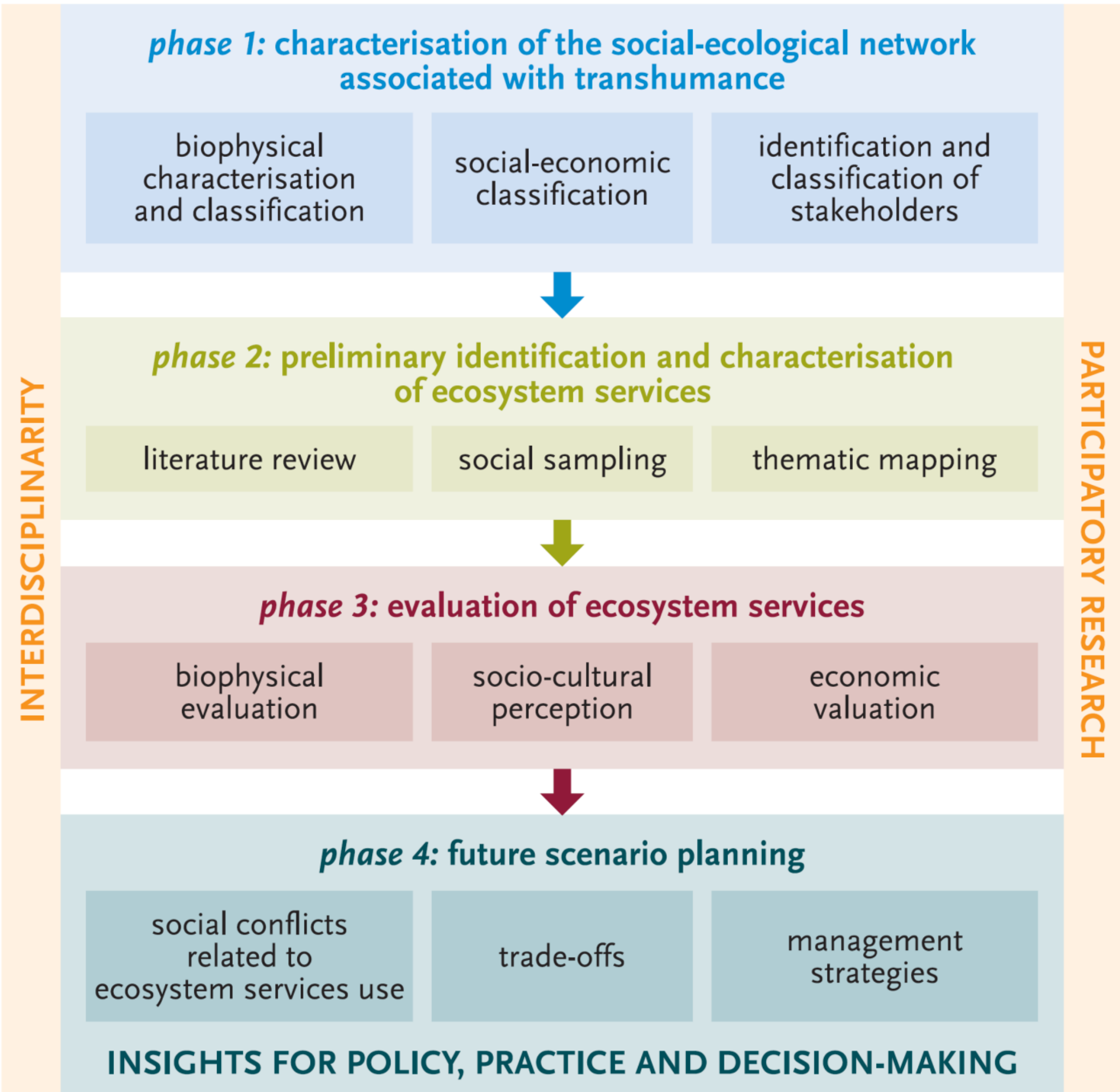

Figure 4.2.1. Methodological framework proposed for the evaluation of ecosystem services provided by the transhumance social-ecological network and its use as a tool for participatory decision-making.

4.2.2.1.Phase 1: Characterisation of the Social-Ecological Network Associated with Transhumance

Looking at transhumant landscapes from a perspective of socialecological networks requires first of all its ecological, social and economic characterisation and stakeholder identification (Liu et al. 2007).

Biophysical characterisation and classification: The aim is to spatially delimit and map ecological units; in our case, those linked to transhumant movement, including both summering and wintering areas as well as drove roads. A multiscalar cartography of the different ecosystems is therefore required. Through ecological classification, discrete and homogeneous units are obtained that are distinct from one another and can be described by the bio physical variables selected (Klijn and Udo de Haes 1990). The underlying assumption here is that the factors used for the classification determine the biological response of the ecosystems to human actions, so that in every ecological unit, the biological response would be homogeneous.

Social-economic classification: An integrated and quantified description of the various social components of the social-ecological network and their reciprocal relations can be obtained not only by a superposition of social-economic data but also by analyzing how the different administrative units (e.g., municipalities) relate to each other and to the natural system. Every unit is described following a list of socio-economic and cultural variables (e.g., population size and age, unemployment, educational level, household size, economic activity, land-use and ownership), which are grouped using a multivariate analysis (de Aranzábal et al. 2008).

Identification and classification of stakeholders: It is essential to identify differences and convergences in the stakeholders' relationships with the ecosystem services and management practices, their visions and priorities, and their management capacities. Semi-structured interviews with key informants and a classification analysis of social perceptions are used to characterize the different stakeholders. Environmental behaviour variables, other socio-cultural (such as sense of place) and demographic (such as age, gender or parental origin) variables and local ecological knowledge (of transhumance and drove roads, in our case) are used to describe each of the stakeholder groups.

4.2.2.2. Phase 2: Preliminary Identification and Characterisation of Ecosystem Services

The information necessary for the evaluation of ecosystem services (in phase 3) is gathered by using three different methods.

Literature review: Previous works on ecosystems and ecosystem services related to transhumance and other related issues (e.g., pastoralism and livestock movements) are reviewed.

Social sampling: We use deep, semi-structured interviews with key informants, specifically local inhabitants from the entire study area, experts from academia (ecology, anthropology and history), decision-makers and institutional representatives. Interviewees are asked to discuss the past, present and future of transhumance, related ecosystems, ecosystem services and the drivers of change that have determined the past and might influence the future.

Thematic mapping: Spatially explicit information on land use changes, protected areas and species, as well as any other social and biophysical variables related to the identified ecosystem services are charted.

4.2.2.3. Phase 3: Evaluation of Ecosystem Services

Once ecosystem services have been listed and described, the evaluation (phase 3) takes place. A wide range of methodologies can be used (see De Groot et al. 2010 for a review). The systemic perspective of our framework and the overall aim to highlight the importance of ecosystem services require the combination of three types of evaluation: biophysical, socio-cultural and economic. For an individual evaluation, specific ecosystem services are selected according to the importance stakeholders have given them in the first interviews (see phase 2, *social sampling*).

Biophysical evaluation: Mainly regulating services are evaluated through diverse mapping analyses with geographic information systems (GIS) and remote sensing (e.g., ecological and geological variables modelling), as well as experimental field samplings (e.g., habitat for species, biodiversity, soil erosion control, soil fertility or plant regeneration).

Socio-cultural perception: A social sampling with questionnaires is made based on a representative survey among identified stakeholders. The questionnaire is divided into sections regarding the person's knowledge of the practice (e.g., herders' names, issues about livestock movement or drove road location), social acknowledgement of and dependence on ecosystem services, tendencies and factors affecting ecosystem services flows in the future, responsible institutions and personal questions regarding socioeconomic conditions and environmental attitudes (e.g., recycling habits or visits to protected areas). A further socio-cultural ecosystem services evaluation can be performed through visual tests (e. g., identifying and valuing ecosystem services in photographs of transhumance landscapes and livestock herds).

Economic valuation: The relative importance that the stakeholders assign to ecosystem services can be measured in monetary terms through different valuation methods, which are usually divided into three groups: market-based, revealed preferences and stated preferences (Chee 2004). Market-based methods estimate the contribution of an ecosystem service in different existing markets using production functions, i.e., based on the estimation of the contribution an ecosystem service makes for the production of another service with market value (Mäler et al. 1994), and cost-based methods, i.e., replacement and damage costs, which estimates the potential expenditure incurred in replacing or substituting the eco system service that is lost (Garrod and Willis 1999). Revealed preferences methods infer the value of the service using information about behavioural changes in real markets of a related commodity. The most widely applied techniques are travel costs and hedonic pricing (Freeman 1993). Stated preferences methods avoid conventional markets and explore hypothetical markets through individual questionnaires or discourse-based techniques (Wilson and Howarth 2002, Spash 2007). Most frequently used are contingent valuation, in which interviewees are asked about their individual willingness to pay or accept a payment for a change that affects the quality or quantity of the ecosystem services supply (Mitchell and Carson 1989), and choice modelling in which interviewees choose the most preferred option among the presented alternatives based on the notion that each of the alternatives can be described with a set of attributes and the levels that these attributes take (Hanley et al. 1998).

4.2.2.4. Phase 4: Future Scenario Planning

The objective of phase 4 is to analyse past and future potential social conflicts related to ecosystem services use, trade-offs and management strategies in hypothetical future scenarios. Because social-ecological systems are characterised by uncertainty and are difficult to control, scenario planning is an extremely useful strategy to develop models for adaptive co-management practices[12] that permit a sustainable ecosystem services flow (Peterson et al. 2003, Palomo et al. 2011). The future scenario planning is carried out in a two-day workshop. The participatory process has various aims:

- the participants' reflection on possible future scenarios,
- the strengthening of social capital and the empowerment of participants through debates and interactions that occur during the workshop,
- the proactive analysis of possible and accurate solutions to problems or management practices that can anticipate future crises.

The workshop begins with analysing the changes that have occurred in the network (drivers of change), followed by a discussion of the strategies and adaptations it has developed. Then, plausible future scenarios (description of storylines, analysis of social conflicts and of trade-offs) are characterised and, finally, strategies for the maintenance of ecosystem services flows (backasting) are proposed.

Social conflicts related to ecosystem services use: The workshop provides the input to describe the relationships among the main characteristics of the current state of the social-ecological network. Changes from past to present are also covered, including stakeholders who have benefited from and/or have been affected by these changes.

Trade-offs: Trade-offs and synergies among ecosystem services result from the management of the social-ecological network (Bennett et al. 2009, Gordon et al. 2010). Having at hand information regarding ecosystem services flows and beneficiaries allows for assessing the complex interactions that emerge from ecosystems management, making

[12] We understand adaptive co-management following Folke et al. (2002) as "a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organized process of trial-and-error."

it possible to know and deal with the pros and cons of each action and to assign different priorities (Martín-López et al. 2009). In this sense, the ecosystem services analysis conducted during the workshop results in a trade-offs analysis, both among ecosystem services flows in different scenarios and between different stakeholders (beneficiaries and losers).

Management strategies: By the end of the workshop, a complete, realistic and diverse proposal for management practices, policies and strategies to be taken by different stakeholders at different scales is obtained. From the whole set of measures, the most interesting and robust will be those that were common to all scenarios, independent of whether they were proposed for avoiding a negative aspect or enhancing a positive one.

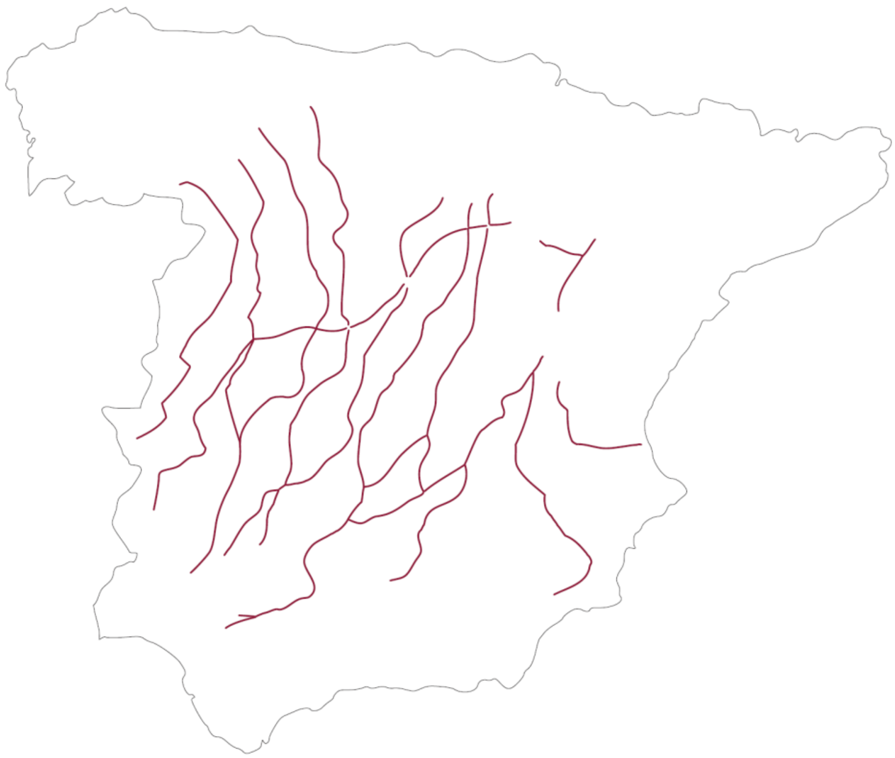

Figure 4.2.2. The major drove roads of the Spanish network for seasonal migra tion of sheep and cattle. Granted legal protection in 1995, the network extends over approximately 125 000 kilometres and occupies roughly 422000 hectares (Cazorla et al. 2008). Not all drove roads are in regular use anymore.

4.2.3. The Conquense Royal Drove Road as a Case Study

Our framework proved its potential use in the study of the CRDR between 2009 and 2011.Within the Spanish network of drove roads (Figure 4.2.2), the CRDR is the longest drove road in Spain that is still used by herders on foot to move their cattle and sheep. It includes a summering area located in the eastern forests of the Montes Universales (the Teruel, Guadalajara and Cuenca provinces), a wintering area located in southeastern Sierra Morena and the southern fields of La Mancha (the Jaén, Córdoba and Ciudad Real provinces), and the drove road itself, a 75-metres-wide (in most parts) corridor that crosses the central Iberian plateau (most ly in the Cuenca and Ciudad Real provinces) for approximately 410 kilometres (Figure 4.2.3). A total of 15 transhumant shepherds walked the drove road in 2009 with 8 886 ovine heads and 1 184 bovine heads (Oteros-Rozas et al. forthcoming).[13]

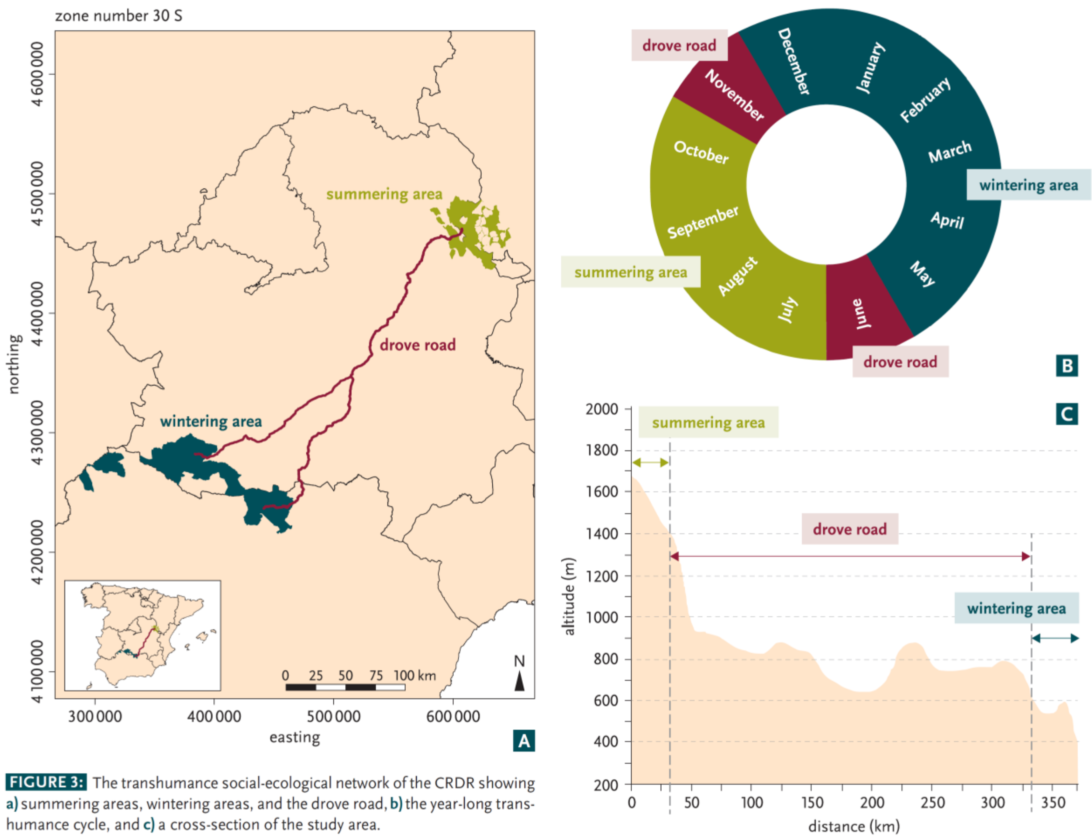

Figure 4.2.3. The transhumance social-ecological network of the CRDR showing a) summering areas, wintering areas, and the drove road, b) the year-long transhumance cycle, and c) a cross-section of the study area.

[13] According to official livestock movement permits granted by the Local Agrarian Offices in 2009, in the CRDR transhumance social-ecological network, a total of 87 shepherds with 57.769 ovine livestock heads were trans humant.Most (72) of the current transhumant shepherds use trucks or trailers to move their livestock. The CRDR shows that transhumance in Spain has made its way into the 21st century, although on a much smaller scale and with a different structure than it had in the past. This transhumance social-ecological network is therefore a unique and interesting example of a living, traditional, sustainable land-use practice positively associated with nature conservation.

From July to November, sheep and cattle herds escape the dry Mediterranean summer by staying in the high plateau and mountainous areas, where they find refuge, food, and water. The summering area is characterised by vegetation of semi-deciduous and coniferous forests mixed with agricultural patches of fodder crops. In early November, when primary productivity drastically declines in the northern forests because of the great decrease in temperature, most shepherds and herds start the 25-to-30-day journey, crossing the central Iberian plateau along the drove road mostly surrounded by cultivated areas (vineyards and fields of sunflowers, cereals, and olives). Winter pasturelands, where shepherds and herds spend the next six months, are more dispersed, being located in lowlands characterised by a typical Mediterranean dehesa landscape, i. e., an agrosilvopastoral system mainly aimed at extensive livestock grazing, but from which also crops and non-timber forest products are obtained (Figure 4.2.4).

Figure 4.2.4. Transhumant herd of sheep in a dehesa within the wintering areas of the CRDR, La Carolina (Jaén, Spain).

Interviewees (in phase 2) acknowledged a total of 33 ecosystem services in the three areas that form the network. Of these, ten were classified (following MA 2005) as provisioning, eleven as regulating and twelve as cultural services. Some of these services are mostly delivered by the summering area (e. g., fire prevention), some are mostly supplied by the wintering area (e. g., tree regeneration) and some by the drove road (e.g., seed dispers al), but most of them are associated with the whole network. In addition, even though not all ecosystem services identified are directly linked to the practice of transhumance, the integrity of the whole social-ecological network is.

Evaluation of ecosystem services provided a quantification of some ecosystem services flows; for some we simply proved their existence or their dependence on the presence of transhumant livestock, but have not yet quantified their supply.

The complete set of techniques that we propose for ecosystem services assessment in our framework (Figure 4.2.1, phase 3) and used in this case study is presented in table 4.2.1.

Table 4.2.1. All the ecosystem services identified and the specific methods of evaluation used in the case of the *CRDR*: biophysical (biophy.), socio-cultural (soc.), economic (econ) market analyses (m.a.) and stated preferences (s.p.). The social value of all the ecosystem services was also evaluated using questionnaires of individual and social perception, and the monetary value was estimated through contingent valuation.

Ecosystem services type	Ecosystem services	Type of evaluation				Data source
		Bio-phy.	Soc	Econ.		
				M.a	S.p.	
Provisioning	gathering (e.g., wild plants)		x	x	x	questionnaires, statistical databases
	manure	x	x	x	x	questionnaires, statistical databases
	feed for animals (e.g., fodder)		x	x	x	questionnaires, statistical databases
	food from livestock (e.g., lamb and beef)	x	x	x	x	questionnaire, statistical databases
	food from agriculture (e.g., oil)		x	x	x	questionnaires, statistical databases
	food from hunting (e.g., rabbit meat)		x		x	questionnaires
	products from apiculture		x		x	questionnaires
	fibre (e.g., wool, fur)	x	x	x	x	questionnaires, statistical databases
	wood and timber		x		x	questionnaires
	genetic pool (e.g., local breeds)		x		x	questionnaires
Regulating	tree regeneration (e.g., dehesa maintenance)	x	x		x	ecological field samplings (oak regeneration in the wintering area), questionnaires
	biological control		x		x	questionnaires

Ecosystem services type	Ecosystem services	Type of evaluation				Data source
		Bio-phy.	Soc	Econ.		
				M.a	S.p.	
	fire prevention (natural hazard)	x	x		x	remote sensing and geographic information system (GIS) tools, statistical analyses of fire frequencies and questionnaires
	connectivity and seed dispersal	x	x		x	GIS tools (fragmentation and travel cost indexes), questionnaires
	maintenance of soil fertility	x	x	x	x	GIS, statistical analyses of secondary information, questionnaires
	soil erosion control	x	x		x	soil sampling, questionnaires
	air purification		x		x	questionnaires
	habitat for species	x	x		x	ecological field samplings (distribution of hunting species, invertebrate taxonomic and functional diversity), questionnaires
	pollinization		x		x	questionnaires
	microclimate regulation		x		x	questionnaires
	hydrological regulation		x		x	questionnaires
Cultural	cultural identity (sense of place)		x		x	questionnaires
	spiritual value		x		x	questionnaires
	nature recreation activities (e.g., sports)		x		x	questionnaires, statistical databases
	recreational hunting		x		x	questionnaires
	bullfighting events		x		x	questionnaires
	rural tourism (e.g., gastronomic)		x		x	questionnaires, statistical databases
	tranquillity/relaxation		x		x	questionnaires
	way of cultural exchange		x		x	questionnaires
	environmental education		x		x	questionnaires
	scientific knowledge		x		x	questionnaires
	aesthetic value		x		x	questionnaires (specific social perception test through photographs)
	local ecological knowledge		x		x	in-depth interviews, focus groups and specific questionnaires

The specific evaluation of ecosystem services as directly or indirectly dependent on transhumance was achieved by comparing scenarios with and without transhumance, where all other variables were as similar as possible (with the same bio-geographical locations, ecological conditions, socio-cultural realities, economic conditions). From a biophysical perspective, we evaluated the capacity to provide different regulating services, such as tree regeneration, habitat for species (focused on both invertebrate and vertebrate taxonomic groups), soil formation and fertility, and fire prevention. In the socio-cultural evaluation, we asked interviewees about ecosystem services that would decrease or be degraded, either quantitatively or qualitatively, if there was no transhumance, and evaluated their perception of ecosystem services in photographs with and without transhumance elements (the drove road and a herd). Finally, from an economic viewpoint, we carried out market analysis of most provisioning services and cost-based analysis for different regulating services (e.g., fire prevention). We also performed a contingent valuation study in which we explored the willingness to pay for maintaining transhumance and the ecosystem services associated to this activity. Three examples of biophysical, socio-cultural and economic ecosystem services assessments are shown in table 4.2.2.

The results of the ecosystem services assessment were then used in a participatory "bottom-up" process to develop and prioritise adaptive co-management strategies for the maintenance of transhumant pastoralism in the CRDR as well as to provide insights for policy-making regarding transhumance at the national level. Participants of the two-day workshop came from the whole range of stakeholders related with transhumance management at different spatial scales (local, regional and national). A tradeoffs analysis conducted during this process showed that current trends are triggering a loss of most regulating (e.g., fire prevention) and some cultural services (e. g., cultural identity),while promoting the production of some other cultural (e.g., recreational services) and provisioning services. Taking into account current patterns of global change (e.g., availability of fossil fuels, climate change), the participants characterised four plausible future scenarios for transhumance in the CRDR and discussed the expected trends of the different ecosystems services in each scenario.

Finally, more than 90 management strategies and actions were proposed in order to foster the desirable aspects and to avoid the negative factors identified in the four scenarios. During the back-casting, participants prioritised the implementation of schemes of payments for ecosystem services, the creation of cooperatives and associations of transhumants, the improvement of product commercialisation and the protection of drove roads against landuse changes as the most urgent needs.

Table 4.2.2. Examples of biophysical, socio-cultural and economic evaluations of three ecosystem services performed in the *CRDR* social-ecological network.

Type of evaluation / Ecosystem service evaluated	Methodological approach	Main results
Biophysical evaluation: structural and functional connectivity provided by the presence of the drove road	A GIS polygon file was built with current land cover in the *CRDR* network. Structural connectivity was evaluated through polygon counts under three different scenarios (absence of drove road, drove road with its actual width and a hypothetical drove road with the legal 75-m width). Functional connectivity was evaluated using the travel cost index (a GIS tool based on resistance). Three types of matrices (forest, drove road and agrarian) and three theoretical matrix resistance values for different wildlife species (low, medium and high) were explored.	The current drove road physically connects seven forest patches comprising 9,350 ha, while a drove road with its legal width would connect 25 forest patches totalling 77,180 ha. Regarding functional connectivity, the presence of the drove road reduces resistance to wildlife movement by 0.2-1 percent on the whole trip between summering and wintering areas (up to ten percent in the case of the drove road with legal width). However, this effect is particularly important in those stretches that cross a highly transformed agrarian matrix, where the resistance reduction effect can reach 62 percent.
Socio-cultural evaluation: aesthetic value of the drove road and livestock presence as perceived by different stakeholders	Questionnaires (*n*=286) were applied to local inhabitants and non-residents, asking them to express their aesthetic preferences when comparing 30 photographic pairs. Pictures in every pair were very similar except for the presence/absence of a drove road, or the presence/absence of livestock. Differences were analysed using Kruskal-Wallis tests and multivariate analyses.	Overall, no significant effect was observed regarding the presence of the drove road in the landscape, but differences were found among certain groups of stakeholders. The presence of livestock in the landscape was positively selected by all consulted stakeholders. Livestock herders (either transhumant or not) and neo-rural people were the stakeholders with a higher preference for the presence of the drove road and livestock in all the landscapes.
Economic evaluation: soil fertility provided by sheep manure in stubble fields of the summering area	Total manure production of sheep was estimated by multiplying the number of transhumant sheep heads by the average daily rate of manure deposition and the number of days sheep spent feeding in stubble fields in the summering area. The equivalent monetary value of fertilisation using sheep manure as fertiliser was calculated at current market prices.	Over 1,000 tonnes of manure are produced every year by transhumant sheep in the summering area, and distributed over 19,000 ha of stubble fields (ca. 54 kg/ha). The monetary investment needed to replace this fertilisation service would reach over 35,500 Euro at market price (not including the labour necessary to distribute manure, another service also provided by sheep).

4.2.4. Lessons Learnt and Insights for Policy-Making and Future Research

The application of our interdisciplinary and participatory methodological framework to the transhumance social-ecological network of the CRDR provided useful insights, which may be of interest for other similar studies:

- By highlighting the close links between ecosystems and human well-being (through the concept of ecosystem services), the framework was effective at drawing attention from civil society and facilitated the mobilisation of different stakeholders, particularly decision-makers.

- The methodological framework allowed researchers to address problems from a systemic angle and contributed to break down territorial barriers by considering the whole system as a social-ecological network with multiple connections at different spatial scales.

- All the phases of the methodological framework were embedded in an interdisciplinary research approach. The ecosystem services concept provided a common language that contributed to improve understanding and communication between the social and biophysical sciences and facilitated working under a single comprehensive and holistic perspective.

- The participatory research approach promoted the dialogue of complementary knowledge paradigms, putting scientific (experimental learning) and local (experiential learning) knowledge on the same level.

Our interdisciplinary and participatory framework provided a base line upon which adaptive co-management strategies could be developed and tested. It basically contributed by encouraging stakeholders to share management responsibility while learning from their actions (Rui tenbeek and Cartier 2001).

It also fostered delib erative activities, which are considered as a key component of adaptive co-management systems (Dai ly et al. 2009). Shared visions about current problems, future scenarios and possible alternatives for transhumance revitalisation were built in workshops and focus groups. Moreover, our framework tackled some other key features that characterise adaptive co-management (Armitage et al. 2007). Multi-scale stakeholders were involved and encouraged to develop higher degrees of dialogue, interactions and collaboration. The need to share out responsibilities for action and decision-making emerged from several of the management strategies suggested to support transhumance. The active search for consensus allowed all stakeholders, at different levels, to cooperate in search of win-win solutions that enable economic, social and ecological sustainability of transhumance. Finally, the whole process allowed stakeholders to more easily recognise and embrace un certainty (e.g., global markets tendencies, Common Agricultural Policy or climate change), hence alleviating tensions and opening their minds for innovation and systematic learning.

The ecosystem services assessment proposed here has contributed to the conservation and support of the drove road system and the transhumance cultural landscapes by:

- scientifically proving the existence of some ecosystem services related to transhumance (e. g., tree regeneration in dehesas) that, to date, had just been hypothesised,
- providing primary data about some ecosystem services in transhumance cultural landscapes, therefore making the dependence of human well-being on agro-ecosystems more visible to society,
- providing information about people's motivations for maintaining these ecosystem services,
- drawing attention to the consequences of land-use changes in terms of ecosystem services trade-offs,
- facilitating the implementation of precise locally driven actions and management measures for the conservation of transhumance in the region, and
- developing a broad interdisciplinary vision for landscape management at the national level based on the maintenance of the wide spectrum of ecosystem services supplied by the transhumance social-ecological network.

Case studies such as the one presented here are vital to transfer conceptual constructs into operative actions and face new challenges in ecosystem services assessment while enriching researchers with experiences, skills and tools. In addition, our methodology integrates into a single and comprehensive framework the different facets that, according to Seppelt et al. (2011), should characterise the holistic ideal of ecosystem services research, by using an integrative approach that considers biophysical, socio-cultural and economic indicators and measures, deriving results from primary data, evaluating simultaneously diverse ecosystem services in order to explore trade-offs and synergies, considering uncertainty in ecosystem services assessment, and involving stakeholders throughout the whole research process.

All in all, we believe that the proposed framework can be applied to other cultural landscapes or social-ecological systems, especially in the Mediterranean region. Conceptual and methodological frameworks such as the one presented here can foster new paradigms of interdisciplinary and participatory science-based action that could allow society to successfully face the challenges associated with the current patterns of global change.

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Capítulo 4.3

Valorando socio-culturalmente los servicios generados por los ecosistemas vinculados a la red socio-ecológica de la trashumancia

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En revisión en *Regional Environmental Change.*

4.3. Socio-cultural valuation of ecosystem services in a transhumance social-ecological network

Abstract The ecosystem services framework is receiving increasing attention in policy and research. Exploring human attitudes and perceptions regarding ecosystem services has been proposed as a promising tool for dealing with complex problems associated with environmental change, particularly in the context of cultural landscapes. Transhumance is a farming practice responsible for shaping cultural landscapes and an adaptive strategy based on mobility that seems a useful strategy to deal with growing challenges posed by accelerated environmental change. Socio-cultural valuation of ecosystem services associated with the Conquense Drove Road, one of the major transhumant networks still in use in Mediterranean Spain, was conducted via 416 questionnaires of local residents and visitors in order to capture their perceptions concerning the importance of 34 ecosystem services (10 provisioning, 12 regulating, and 12 cultural) for social and personal well-being. The ecosystem services considered most important for social well-being were fire prevention, air purification and livestock. Most of the ecosystem services were perceived as undergoing a negative trend, except those associated with recreation, scientific knowledge and environmental education. Respondents revealed differing perceptions regarding the value of ecosystem services, depending on their age, place of origin and gender. Some methodological issues and implications of socio-cultural valuation for policy making are finally discussed.

Keywords Drove roads, ecosystem services, human well-being, perception, rangelands, spatial and temporal scales, stakeholders, value

4.3.1. Introduction

The ecosystem services framework is increasingly being used in the policy and practice of environmental management (e.g., de Groot et al. 2002; TEEB 2010; Gómez-Baggethun et al. 2010b; Hauck et al. 2013). Clear indications of this trend are the recent creation of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) and the call of the European Union for all member countries to map and assess ecosystem services by 2014 (European Commission 2011). These efforts are being built on the science of ecosystem services, which has been fostered globally over the past ten years (Fisher et al. 2009; Vihervaara et al. 2010). The original objective of ecosystem services assessments was to clarify the multiple interdependencies between human well-being, ecosystems and biodiversity (Daily 1997). Ecosystem services assessments have been carried out at different spatial scales (from global to local; MA 2005; EME 2011; Pereira et al. 2005), from various value perspectives (i.e., biophysical, socio-cultural and economic), and with a range of objectives such as policy-making support, ecosystem services markets information, or academic aims. The main focus of policy-oriented efforts has been to depict the current state, trends and drivers of change of ecosystem services at national, sub-global and global levels. However, local or regional-scale valuations can provide key inputs for larger-scale assessments, zooming-in to enable deeper understanding of certain social-ecological systems, ecosystem services and/or land-uses. At the same time, local and regional-scale valuations facilitate information transfer to local or regional decision-makers about ecosystem services, their trade-offs and stakeholders preferences.

Ecosystem service supply and demand can be evaluated by focusing on the biophysical, socio-cultural or economic dimensions of their value (Cowling et al. 2008; de Groot et al. 2010). We understand values as “the preferences, principles and virtues that we (up)hold as individuals or groups” (Chan et al. 2012a). The mainstreaming of ecosystem services in the policy context has resulted in the application of the framework not only with the original purpose (as an educational concept to raise public interest concerning biodiversity conservation and human dependence on ecosystems), but increasingly for the quantification of ecosystem services as potentially marketable commodities (Peterson et al. 2010; Gómez-Baggethun et al. 2010). Ecosystem services research has been shaped by the integration of ecological and economic approaches, which has been an important step forward toward the understanding of human–nature relationships (Turner and Daily 2008). However, such approaches are unable to encompass all dimensions of value, thus marginalizing important considerations within ecosystem services research and practices (Chan et al. 2012a). In fact, to date, most studies have focused primarily on monetary and biophysical perspectives and very few studies have chosen to explore socio-cultural preferences toward ecosystem services (Vihervaara et al. 2010; Martín-López et al. 2012). Valuation methods are not ideologically neutral (Gómez-Baggethun et al. 2010b), but rather culturally constructed and, as such, act as value-articulating institutions that become, hence, responsible for the articulation of decision-making processes related to the environment (Vatn 2005).

Non-economic valuations are particularly appealing because of their suitability for uncovering motivations for conserving ecosystem services, which are frequently invisible to monetary valuations. Socio-cultural valuation approaches appear as valuable for acknowledging the diversity of values emerging from the ecosystem services spectrum and to aid in analysis of how human well-being may change alongside ecological change (Chan et al. 2012).

Socio-cultural valuation approaches explore human attitudes and perceptions regarding ecosystem services; thus they may be a particularly relevant tool for valuating ecosystem services in landscapes that have been shaped by long-term human impacts, namely, so-called cultural landscapes (Martín-López et al. 2012). Mediterranean cultural landscapes have developed as a result of close co-evolution of human societies and biophysical systems (Blondel 2006). In such landscapes, high degrees of biodiversity (Myers et al. 2000) and resilience (Cabell and Oelofse 2012) are particularly linked to cultural values and social behaviours and perceptions. Within cultural landscapes, agroecosystems have been recognized as important providers of ecosystem services (Swinton et al. 2007; Zhang et al. 2007; Power 2010; Harrison et al. 2010; Lamarque et al. 2011). Increasing calls for sustainable agriculture are also drawing attention to its social-ecological nature and the idea that agriculture produces landscapes that are at once social, cultural, and ecological (Wittman 2009; Bacon et al. 2012). They supply provisioning services, such as food and fibres; regulating services, such as soil fertility and pollination; and cultural services, such as ecotourism, local ecological knowledge and cultural identity. Recently, Seppelt et al. (2011) and Vihervaara et al. (2010) have called for research specifically focused on ecosystem services provided by agroecosystems. Robertson and Swinton (2005), among others, have proposed that more information about services provided by agroecosystems is needed if depletion trends are to be reversed. Specifically, the ecosystem services framework could help minorities to find their voice for expressing the multidimensional value of their practices to society (Chan et al. 2012b), which could be particularly appealing for peasants and pastoralists.

Especially since the 1960s, Mediterranean agroecosystems have become increasingly vulnerable to the pressures of global drivers of change (e.g., Gómez-Baggethun et al. 2010a; EME 2011) that have (a) have favoured the maximization of outputs from single ecosystem services (mainly food production) against the traditional multifunctional mosaic in fertile areas (Gordon et al. 2010) and (b) triggered rural abandonment of less productive and remote areas (Caraveli 2000; Bugalho et al. 2011; García-Llorente et al. 2012). Pastoral practices in the Mediterranean are renowned for significantly contributing to biodiversity, especially in mountain ecosystems and rural areas (Hatfield et al. 2006). Heikkinen et al. (2012) have recently discussed about herding to be seen as a user and/or a producer of ecosystem services. Current livestock farming systems in mountains and other less-favoured areas are considerably diverse (Ruben and Pender, 2004) and, as farming systems in general, constantly changing in response to biophysical and socio-economic drivers (Mottet et al., 2006), what makes their study of particular interest in the context of the on-going environmental change. Pastoralism in particular is a vulnerable practice declining all over the world (Dong et al. 2011) that might however be crucial for food security under global climate change (Krätli et al, 2012).

Transhumance is a customary practice consisting of regular, seasonal migration of livestock between summer pastures (usually highlands or more extreme latitudes) and winter pastures (lowlands or latitudes closer to the equator) (Ruiz and Ruiz 1986). As other adaptive strategies based on mobility (Agrawal et al. 2008), transhumance seems important as a useful strategy to deal with growing challenges posed by accelerated environmental change (Oteros-Rozas et al., forthcoming). However, as a result of the progressive integration of animal production into the global market economy, sedentarisation policies and institutional constraints that disfavour nomadic lifestyles, mobile pastoralism is globally declining (Davies and Hatfield 2007; Galvin 2009). The decline of transhumant practices is contributing to the current trend of the depleted capacities of Mediterranean agroecosystems to provide a diverse flow of ecosystem services (Gordon et al. 2010) and their lowered social-ecological resilience to global change (Oteros-Rozas et al. 2012a).

Here, we conceptualize the transhumance cultural landscape as a social-ecological network (Janssen et al. 2006), that is, as a "network of biophysical and social flows generated and maintained by the movement of herders and livestock" (Oteros-Rozas et al. 2012b). Our main aim here is to explore socio-cultural perceptions of ecosystem services provided by such a transhumance social-ecological network. Our specific objectives are to (1) analyse perceptions of the "social" (for the well-being of society) and "personal" (for the well-being of the respondent) importance of ecosystem services and compare them; (2) assess perceptions of ecosystem services' trends and their importance for social well-being; (3) explore perceived spatial and temporal patterns of the delivery of ecosystem services; (4) relate socio-demographic characteristics of stakeholders to their perceptions of important ecosystem services and (5) highlight the role of transhumance for the delivery of ecosystem services. Finally we discuss the political and practical implications for safeguarding ecosystem services provided by transhumant pastoralism.

4.3.2. Methods

4.3.2.1.Study area: the Conquense Drove Road social-ecological network

Transhumance has persisted in Spain from ancient times until today, although with a different structure and at a much smaller scale than in the past (Bunce et al. 2006; Manzano and Malo 2006; Fernández-Giménez and Fillat 2012). The most recent estimates tally approximately 250,000 transhumant sheep, of which 90% are moved by truck and 10% by foot (MARM 2011). Recent increases in oil and fodder prices seem to be raising the willingness of some shepherds to resume transhumance on foot (Oteros-Rozas et al. 2012a; Fernández-Giménez and Fillat 2012). This tentative revitalization is made more feasible by a still-existing public network of drove roads that connect winter and summer pasturelands – covering 125,000 km in length and 422,000 ha in overall area, and comprising 0.83% of the entire country (Cazorla et al. 2008) – which has been granted legal protection (Drove Roads Act, Ley 3/1995). The network is formed by nine main Royal Drove Roads (cañadas reales, 75m wide) and hundreds of smaller droves (cordeles, cordones and veredas).

Our study area covers a total of 15,297 km2 in 77 municipalities and is divided into three areas related to transhumance through the Conquense Drove Road (CDR): a summering area, a wintering area and the drove road itself (Fig. 4.2.1). The CDR is the most extensive drove road in Spain (approximately 410 km long) that is still in use by herders to migrate cattle and sheep on foot.

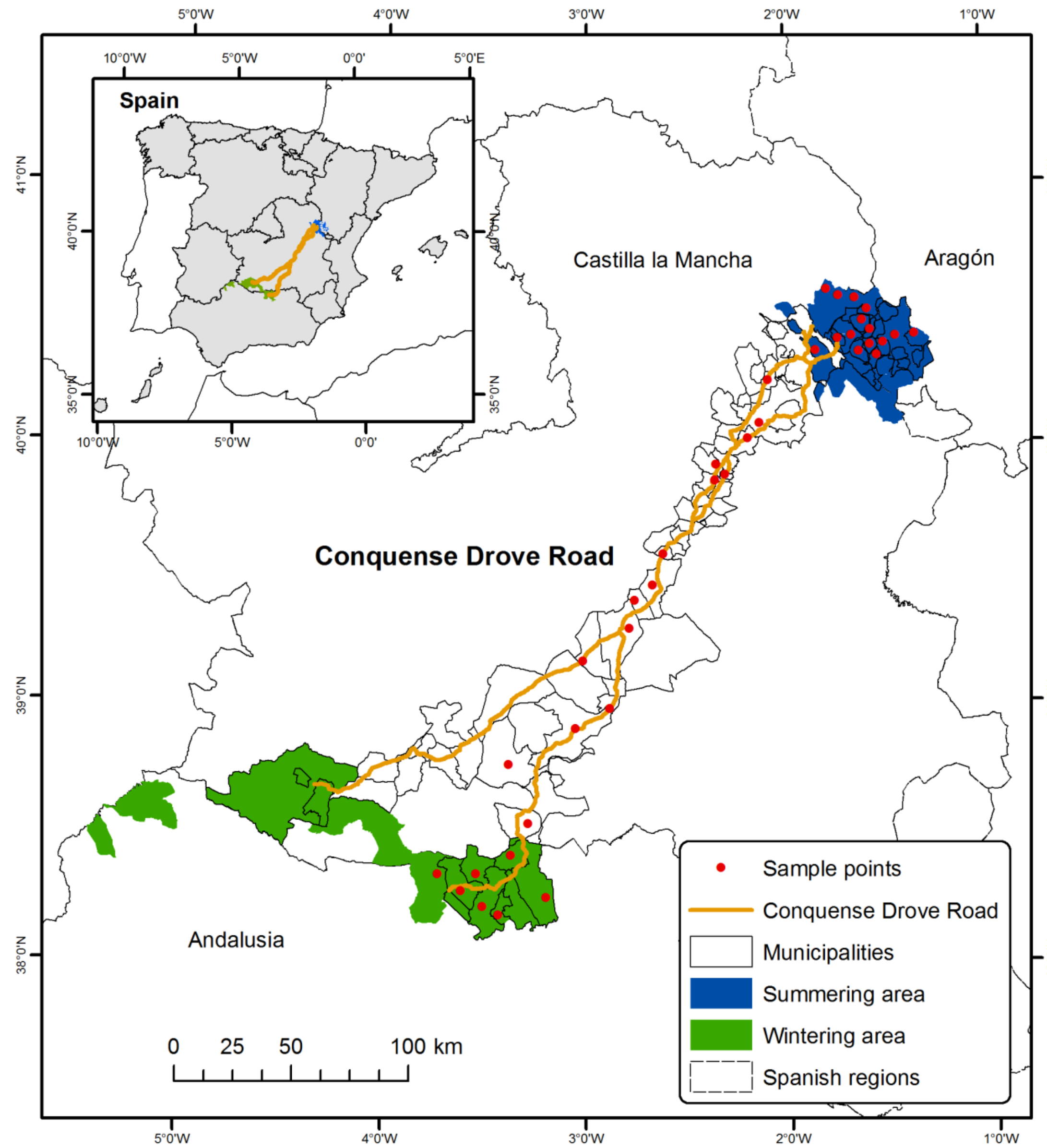

Figure 4.3.1. Map of the study area. Red dots indicate sampling points.

The CDR's summering area is located in the eastern forests of the Montes Universales (Teruel, Guadalajara, and Cuenca provinces), characterised by semi-deciduous and coniferous forests (largely transformed by humans into pine plantations) mixed with agricultural patches of fodder crops. From July to October, sheep and cattle herds graze in these highland pastures, and in early November, when primary productivity drastically decreases, some shepherds and herds start the 25- to 30-day journey along the drove road that crosses the central Iberian plateau, predominantly a cultivated landscape (mostly vineyards and fields containing sunflowers, cereals, and olive orchards). The wintering area is located in south-eastern Sierra Morena and the southern fields of La Mancha (Ciudad Real and Jaen provinces), characterised by a typical Mediterranean dehesa landscape (agrosilvopastoral ecosystems of pasturelands with scattered trees, mostly holm oaks). The altitude of the study area ranges from 270 m (wintering area) to 1,930 m (summering area). Every year, between 13 and 17 transhumant shepherds with almost 9,000 ovine heads and 1,200 cows walk the drove road (Oteros-Rozas et al. 2012a). These constitute, however, only 17% of transhumants in the study area, as most livestock (approximately 57,000 heads) is transported between the summering and the wintering areas by truck.

4.3.2.2.Data collection

Data was collected in three consecutive steps: (1) review of background information, (2) semi-structured interviews, and (3) systematic data collection (survey). Steps (1) and (2) formed background work needed to document the ecosystem services that would later be valued through the questionnaire (3). In the first step (1), preliminary identification and characterization of ecosystem services was carried out by reviewing previous work on ecosystems and ecosystem services related to pastoralism and livestock movements in general and to transhumance in particular (Oteros-Rozas et al. 2012b). The second phase (2) consisted in semi-structured interviews (*N* = 58) with key informants, selected through a snowball sampling technique (Bernard 2005), including shepherds (33%), farmers (21%), hunters (19%), decision makers (23%), employees from the tertiary sector (8%), and university researchers (6%). A total of 34 ecosystem services were identified: 10 provisioning, 12 regulating, and 12 cultural (Appendix A). Drawing on the information gathered in the first two steps, a questionnaire was then designed, pre-tested (*N* = 20) and applied through face-to-face conversations with a sample of respondents (*N* = 416) representative of the local population and visitors of the study area in 39 sampling points (Fig.4.3.1). The sample population was restricted to individuals older than 18 years of age. All incomplete questionnaires were excluded from the analysis (final *N* = 381, Table 4.3.1). Field work was conducted from May 2009 to March 2010 by E.O.R, J.A.G. and B.M.L. and a team of six trained field assistants with a background in environmental sciences.

Table 4.3.1. Characteristics of the sample.

	Frequency	%
Sampling area		
Summering	97	25.46
Wintering	118	30.97
Drove road	166	43.57
Residence		
Local summering	63	16.54
Local drove road	143	37.53
Local wintering	111	29.13
Non-local	64	16.80
Family		
From the study area	262	68.77
From somewhere else	199	31.23
Protected Areas (PA)		
Visitor	287	75.33
Non-visitor	94	24.67
Reading environmental publications		
Never	56	18.54
Rarely	119	39.40
Frequently	87	28.81
Always	40	13.25
Home garden / organic food		
Never	55	14.44
Rarely	65	17.06
Frequently	180	47.24
Always	81	21.26
Recycling		
Never	59	15.49
Rarely	34	8.92
Frequently	62	16.27
Always	226	59.32
Gender		
Men	223	58.53
Women	158	41.47
Age		
<20	7	1.84
20-30	88	23.10
31-40	99	25.98
41-50	102	26.77
51-60	54	14.17
61-70	25	6.56
>70	6	1.58
Educational level		
None	11	2.89
Primary school	99	25.98
Secondary school	129	33.86
University	142	37.27
Professional background		
Primary sector	44	11.55
Secondary sector	7	1.84
Tertiary sector	261	68.5
Student	14	3.67
Education/Research	39	10.24

	Frequency	%
Retired	16	4.2
Monthly net income (Euros)		
< 700	68	17.85
700-1,400	189	49.61
1,401-2,100	75	19.69
2,101-2,800	28	7.35
> 2,801	12	3.15
Not declared	9	2.35

The questionnaire included items on the socio-cultural valuation of ecosystem services (first in general and then specifically related to transhumance), on environmental awareness and behaviour (e.g., readers of environmental publications, members of environmental associations, visitors of protected areas) and on socio-demographic characteristics (e.g., age, gender, income) of the respondents. For the valuation of ecosystem services, respondents were (1) given a brief explanation regarding the study area (with the assistance of a map). They then (2) received a brief explanation of the ecosystem services concept, as "the benefits that ecosystems provide for human well-being". Afterwards they were asked to what extent they considered the ecosystems of the study area to provide services to society (nothing, little, some or much) and they were requested to list the ecosystem services they perceived. The interviewer then presented three visual panels listing, describing and presenting examples and pictures of the 34 ecosystem services (provisioning, regulating and cultural) identified by the research team. We then asked them to select the three ecosystem services they considered most important for social well-being and to rank them in terms of their importance. Subsequently, we enquired about where (wintering, summering and/or drove road) they perceived those ecosystem services being provided, and when (summer, autumn, winter and/or spring) are they mostly delivered. Afterwards, we asked which trend (increasing, decreasing or stable) they perceived the chosen ecosystem services to be following. Respondents then scored each of the three selected ecosystem services according to their importance for their own personal well-being. Finally, they selected a maximum of three ecosystem services that would be lost or degraded if transhumance on foot (as opposed to by truck) disappeared. Two models of the questionnaires and panels, each having different ordering of the ecosystem service listings, were used in order to avoid position bias (Bateman et al. 2002).

4.3.2.3. Data analysis

In relation to objective (1), importance for social well-being was a mean, calculated according to the position in the ranking (1st = 3; 2nd = 2 and 3rd = 1), and the importance for personal well-being was calculated as the mean score (no importance = 1; little importance = 2; some importance = 3; very important = 4) that interviewees gave the selected ecosystem services for the satisfaction of their personal well-being. A Spearman correlation test was used to explore associations between personal and social well-being.

In order to tackle objective (2) we depicted histograms of frequencies for the perception of the trends followed by ecosystem services and developed an index reflecting the overall perceived trend as:

$$\text{overall perceived trend} = \left[\frac{I - D}{I + D + M}\right]$$

where I = frequency of "increases"; D = frequency of "decreases"; M = frequency of "is stable".

To explore the temporal and spatial patterns of ecosystem services delivery (objective 3), we performed Chi-square tests in order to analyse the associations between the delivery of ecosystem services and season (i.e., winter, spring, summer, or autumn) or location (i.e., wintering area, drove road, or summering area). Then, we graphically represented these significant associations for each season/location.

Regarding objective (4), we performed a redundancy analysis (RDA) in order to identify socio-demographic factors underlying the importance of particular ecosystem services for social well-being (Martín-López et al. 2012). A Monte Carlo permutation test (500 permutations) was performed to determine the significance of independent variables in influencing perception of the importance for social well-being of ecosystem services. The inertia of the factors was used to identify the most important variables according to socio-cultural perception.

In order to accomplish objective (5), namely, to explore perceptions of the relation between transhumance and delivery of ecosystem services considered important for social well-being, we employed a scatter plot and a Spearman correlation test to compare the sample shares that believed a particular ecosystem service would be lost or degraded if transhumance disappeared with the shares agreeing that a particular ecosystem service is important for social well-being.

4.3.3. Results

4.3.3.1. Scales of perception: social and personal well-being

Among provisioning services, livestock, food from agriculture and genetic pool were considered the most important for social well-being and were also scored among the most important for personal well-being, together with feed for animals and food from hunting. The ecosystem services considered most important for social well-being were all regulating: air purification, followed by habitat for species and fire prevention (Fig. 4.3.2, Appendix B). In addition to these, tree regeneration, microclimate regulation and hydrological regulation were also frequently selected for their importance for social well-being. The importance for personal well-being of all regulating services was scored with considerably high values (>3), except for biological control and ditch maintenance[14]. The cultural services perceived as most important for social well-being were cultural identity and spiritual value. Several others also considered of high importance for personal well-being were tranquillity/relaxation, scientific knowledge, environmental education, bullfighting events, aesthetic value and local ecological knowledge. A significant and positive correlation was found between the average importance for social well-being and the average score of importance for personal well-being (*Rho* = 0.582; *p*-value<0.001).

4.3.3.2. Perceived trends in ecosystem services delivery

The index of overall perceived trends showed that the delivery of most ecosystem services was perceived as decreasing or stable, except for three cultural services (Fig. 4.3.2): nature recreation activities, scientific knowledge, and rural tourism. In contrast, livestock, fire prevention and air purification were the most frequently perceived

[14] Particularly in the summering area, the ditches (where herbaceous vegetation tends to proliferate due to higher humidity) are grazed by sheep, hence avoiding accumulation of potentially inflammable biomass and facilitating the drainage of rain so that roads are not flooded. The cleaning of biomass from the ditches is usually carried out mechanically, but sheep grazing also delivers this service.

as decreasing. However, fire prevention was also perceived as increasing by 49% of the sample, therefore showing some dissent within it. Considering the index of overall perceived trends and the averages of importance for social and for personal well-being, the ecosystem services showing strongest decreasing trends but high importance for human well-being at different scales were air purification and hydrological regulation. In contrast, two out of the three increasing ecosystem services (i.e. nature recreation activities and rural tourism) were perceived as being among the least important for both social and personal well-being.

Figure 4.3.2. Ecosystem services perceived trends and importance for social and personal well-being. For "Trend frequencies": "Increased" represents the percentage of respondents selecting an ecosystem service that they considered to be increasing; "Decreased" represents the percentage of respondents that consider an ecosystem service to be decreasing; and "Stable" represents the percentage of respondents who believed that an ecosystem service is not changing. For more details regarding social well-being and personal well-being, see the Methods section and Appendix B.

4.3.3.3. Perceived season and location of ecosystem services delivery

Participants in the study exhibited perception of a differentiated delivery of ecosystem services, depending on the time of year (Fig. 4.3.3.A) and the three different areas involved (Fig. 4.3.3.B). Different cultural services were related to each of the four seasons: recreational hunting in autumn and winter; rural tourism in summer; and nature recreation and aesthetic value in spring. Provisioning services, in contrast, were perceived to be provided more in autumn (gathering) and winter (fibres). Some regulating services were particularly associated with spring (connectivity and seed dispersal, tree regeneration and pollination) and, fire prevention was perceived to be preferably delivered in summer.

Only four ecosystem services were considered to be significantly more associated with a particular area (Fig. 4.3.3.B). Fire prevention was clearly perceived to be provided in the summering area. The drove road was particularly related to food from agriculture, maintenance of soil fertility and as the way of cultural exchange.

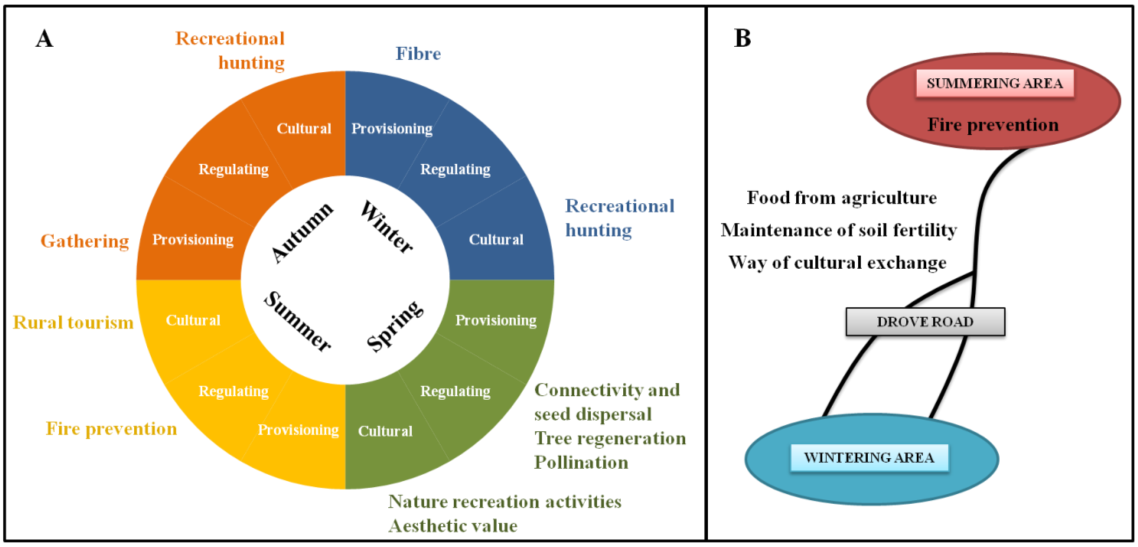

Figure 4.3.3. (A) Significant associations between seasons of the year and ecosystem services delivery perceived by respondents and according to χ^2 tests (p-value <0.05). (B) Significant associations between spatial location and ecosystem services delivery perceived by respondents and according to χ^2 tests (p-value <0.05).

4.3.3.4.Different stakeholders, different values

The RDA indicates a statistically significant relationship between the ecosystem services perceived as being important for social well-being and the socio-demographic characteristics of respondents (*p*-value<0.0001, from 500 permutations).The three principal axes of the RDA accounted for 71% of total variance (Table 4.3.2). The first axis was positively related to local ecological knowledge, fire prevention, soil erosion control, and feed for animals, mostly selected by older people, readers of environmental literature, locals from the summering areas and/or farmers. The negative values of this axis were related to air purification, ditch maintenance and food from agriculture, preferably selected by locals from the drove road area (Fig.4.3.4).

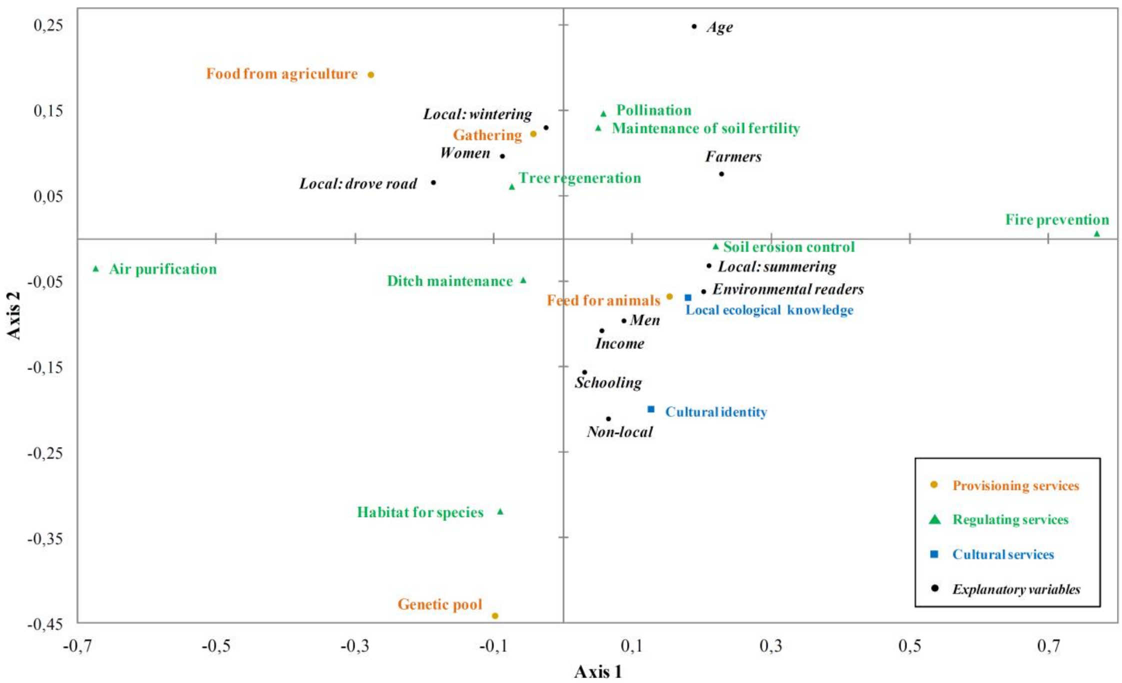

Figure 4.3.4. Scatter plot of first two axes of the Redundancy Analysis (RDA). The tags shown correspond to active variables (ecosystem services) with a squared cosine >0.3 in axis 1 or axis 2 of the RDA and to explanatory variables (socio-demographic, in italics).

In the positive extreme of the second axis, we found nature recreation activities, maintenance of soil fertility, pollination and gathering, mainly selected by older interviewees living in the wintering area. On the negative side of axis 2, people with higher educational level, higher income level, and/or not living in the study area tended to perceive habitat for species and genetic pool (Fig. 4.3.4).

Finally, along the third axis, bullfighting events, connectivity and seed dispersal, manure and livestock were grouped on the positive side, identified by locals from the summering area, men and/or farmers. Meanwhile, on the negative side of this axis, interviewees employed in research or education, women, and/or people with higher educational level and/or income levels were more inclined to select tree regeneration and soil erosion control.

4.3.3.5.Transhumance and ecosystem services

A positive correlation (*Rho* = 0.616; *p*-value<0.001) was found between the percentage of the sample that considered an ecosystem service would be lost/degraded if transhumance disappeared and the percentage of people considering a particular ecosystem service to be important for social well-being. Livestock and fire prevention were perceived as most important for social well-being and related to transhumance (Fig.4.3.5). The delivery of certain regulating services (tree regeneration, maintenance of soil fertility and connectivity and seed dispersal) and cultural services (local ecological knowledge, way of cultural exchange and cultural identity) were noted by 7-13% of the sample as being closely related with the existence of transhumance, mostly seen as being decreasing but important for social well-being. Finally, 60% of the ecosystem services perceived as being important for social well-being were considered to be related to the maintenance of transhumance.

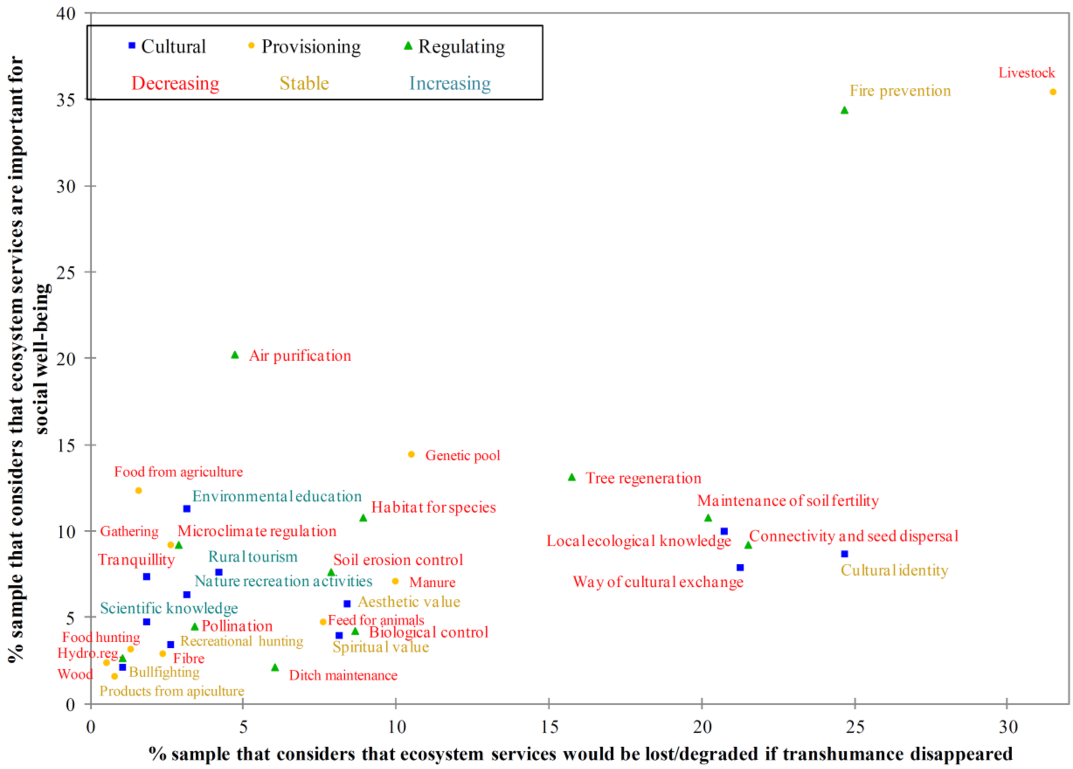

Figure 4.3.5. Scatter plot of the percentage of the sample believing that ecosystem services would be degraded or lost if transhumance disappeared (x axis) and the percentage of the sample considering particular ecosystem services important for social well-being (y axis). Symbol indicates type of ecosystem service, and tag color corresponds to the overall perceived trend (see Fig. 4.3.1).

4.3.4. Discussion

Socio-cultural valuation has proved to be a useful approach that enables identification of a whole range of ecosystem services; assessment of their importance for human well-being at two different scales (social and personal) and in different seasons and locations; identification of links between socio-demographic factors and ecosystem services perception; and creation of early warning prognoses regarding ecosystem service states and trends, based on local knowledge and perceptions.

4.3.4.1. Social perception of ecosystem services: self-oriented vs. other-oriented

Social scientists have documented that, when an individual expresses values based on the benefits (consequences) that something has for her, this response also reflects an implicit willingness to contribute to a moral cause (Kahneman and Knetsch 1992) and, thus, can be seen as a measure of an index of support for a morally right or just society, but not as an individual preference (Sagoff 1998). For this reason, respondents were primarily asked to select ecosystem services according to their importance for social well-being and, afterwards, score them according to their personal importance. The combination of the two approaches allowed us to distinguish between self-oriented and other-oriented preferences (Chan et al. 2012a). The significance of the scale of perceptions in socio-cultural ecosystem services assessment is important because each perspective can provide different kinds of information. While perception of the importance of regulating services was similar for both social and personal well-being, different patterns appear for cultural and for provisioning services (Appendix B). When asked about social well-being, a subjective perception of general needs and preferences was unfolded: in this case respondents tended to give higher values to provisioning services. When enquired about personal well-being, subjective values rose more clearly. In this case, higher values corresponded to cultural services. Based on our results, we suggest that both scales should be explored in future socio-cultural valuations.

4.3.4.2.Identifying key ecosystem services

Only three ecosystem services were perceived to be increasing: nature recreation activities, rural tourism and environmental education (Fig.4.3.2). All of them are ecosystem services demanded mainly by urban users (EME 2011; Martín-López et al. 2012), and two of them are related to recreation activities, which is consistent with other studies in Europe (e.g., Harrison et al. 2010). This is not surprising, taking into account that the rural development policies included within existing European and Spanish policies have arguably widened the gap between intensively productive areas and abandoned or extensively managed areas. The tertiary sector has been promoted, especially tourism and recreation, as a source of income diversification in disadvantaged areas. These strategies have, on the one hand, provided some rural communities with economic alternatives in the face of lowered market competitiveness of European agrarian products, therefore downshifting or reversing abandonment. On the other hand, the substitution of primary and secondary sector activities by tertiary sector activities (mainly tourism) has triggered abandonment of most low-impact extensive and traditional agrarian practices and their related cultural landscapes (Caraveli 2000).

Ecosystem services considered most important for social well-being and in degradation should be considered as key ecosystem services and should, therefore, attract priority attention in decision-making. In the study area, regulating services (air purification and hydrological regulation in particular) and food provision (genetic pool – e.g., landraces and livestock breeds – and food from agriculture and from livestock) showed an overall decreasing trend while being very important both for social and personal well-being.

Moreover, we found that key ecosystem services varied according to spatial and temporal scales. On the one hand, we found that all ecosystem services related with the drove road are decreasing (Fig.4.3.3B), specifically food from agriculture and maintenance of soil fertility, which are considered important for personal well-being. These ecosystem services are probably associated with the drove road because it is frequently embedded in a matrix of croplands. On the other hand, our results indicate that some of the ecosystem services clearly delivered in one season are also important for personal well-being, such as fire prevention or tree regeneration (Fig.4.3.3A). In this context, the calendar of ecosystem services proves to be an interesting tool to (a) depict possible complementary activities (e.g., gathering and recreational hunting in autumn and winter, and recreation activities in summer) and (b) identify different understandings of ecosystem functions or survey questions (e.g., fire prevention is perceived as being provided mostly in summer, when fire frequency is highest, while the accumulation of inflammable biomass takes place particularly in spring).

The case of fire prevention deserves specific attention. Fire hazards are a common concern of the Spanish population, and fire prevention was identified as a key ecosystem service in the study area. Fire occurrence has been recognized as negatively associated with livestock grazing (Zumbrunnen et al. 2012). The experience of natural hazards influences human perception of socio-ecological dynamics and, therefore, determines the socio-cultural value of ecosystem services. Preferences, such as those for biophysical processes, are context-specific (Johnson et al. 2012). This survey was carried out in 2010, but what would have happened if we had repeated the survey in summer 2012? In that year, fire hazards were particularly frequent and severe: the number of fire events larger than 500 hectares increased 154% and the area affected increased by 250%, in comparison to the average of the previous five years (MAGRAMA 2012). Socio-cultural valuation is therefore particularly advisable for the case of natural hazard prevention, because it can be used as (a) as an early warning of ecosystem services deterioration and (b) a proxy for risk perception of the increasing probability of natural hazards. However the disensus observed in the perceived trend of fire prevention could be due to a misunderstanding of this ecosystem service: even though we tried to clarify that we were referring to benefits provided by ecosystems – that is, "natural prevention by herbivorous consumption of biomass" – some interviewees may very well have been thinking about "human prevention" (with public investment in mechanical means). This type of misinterpretation can be taken as a caveat, so we should be cautious when interpreting the results regarding this particular service.

4.3.4.3.Who values what?

Individuals perceive and, therefore, value ecosystem services differently according to their socio-cultural backgrounds (e.g., Castro et al. 2011; Lamarque et al. 2011; Martín-López et al. 2012; van Berkel and Verburg 2012; Plieninger et al. forthcoming). Analyses such as the RDA (Fig.4.3.4) which explore the association between ecosystem services and socio-cultural factors can be used to identify ecosystem service bundles based on social perceptions (Martín-López et al. 2012). In the case presented here, most of the ecosystem services that were differently perceived by stakeholders were regulating and provisioning. Particularly non-locals and locals from the three different areas valued different ecosystem services, probably because some kinds of values cannot be adequately appreciated without being experienced (Chan et al. 2012a). Locals from the drove road perceived food from agriculture to be important for social well-being, while locals from the summering area more greatly appreciated food from livestock, likely reflecting the importance of these agrarian practices in each of the local economies. Awareness and familiarity with local surroundings have been previously identified as important determinants of landscape perception (Soini et al. 2012).

Age was also a significant factor influencing perception of the relative importance of ecosystem services for social well-being. While older people mostly perceived local ecological knowledge, nature recreation activities, soil fertility and erosion control, fire prevention, pollination and gathering, younger people more often perceived food from agriculture, air purification, habitat for species and genetic pool. Is this a sign of a change in preferences consonant with life experience? Is there an intergenerational change in values? Or does it signal, perhaps, a change in the ecosystem services delivered? Probably a confluence of these three factors is occurring. Needs change over the course of a lifetime, probably in relation to one's main occupation: while elders enjoy recreation and value their local knowledge, the young may have received more formal environmental education and, therefore, value regulating services, but, also being still-active workers, are likely to value food production activities and, thus, food provision services. Further research could be conducted in this regard.

A gender difference emerged in the valuation of ecosystem services: while men tended to consider most important ecosystem services to be related with livestock raising (i.e., livestock, manure, connectivity and seed dispersal and bullfighting events), women mostly perceived regulating services (i.e., tree regeneration and soil erosion control). Gender differences in the valuation of ecosystem services have previously been identified (Martín-López et al. 2012) and explained in accordance with gender-differentiated environmental awareness (Dietz et al. 2002) and the gender division of work (Rocheleau et al. 1996; Reyes-García et al. 2010).

4.3.4.4. So what if transhumance disappears?

The existence of transhumance is perceived to be an influencing element in the delivery of ecosystem services, some of which are valued as highly important for human well-being, especially fire prevention. Policy–action toward the conservation of transhumance can positively influence the provision of ecosystem services in the study area and the resilience of the social-ecological network (Oteros-Rozas et al. 2012a). Transhumance, as a mobility strategy, has been recognised as an important adaptive strategy in the face of global change (Berkes and Jolly 2001). We also argue that it can be considered an "intermediate disturbance", capable of managing ecosystems for the delivery of a diverse flow of ecosystem services. Between the extremes of management for the satisfaction of urban demands and worldviews (looking either for the production of food, as in intensive croplands, or the optimization of regulating and cultural services, as in protected areas) and land abandonment, peasant multifunctional management models associated with low-impact agrarian practices should gain greater attention for their role in preserving cultural landscapes responsible for the delivery of a wide range of ecosystem services (Harrop 2007; García-Llorente et al. 2012). We believe transhumance maintenance can be particularly important in the Mediterranean basin, taking into account the future scenarios of regional climate and land-use change and the forecasted alterations in ecosystem services supply (Schröter et al. 2005). The promotion of multifunctional landscapes through a form of transhumance preservation that seeks to guarantee delivery of a diverse flow of ecosystem services should be considered for the design of future agro-environmental measures in the face of the current reform of the Common Agricultural Policy of the European Union for the period 2015-2020.

4.3.5. Conclusions

The present study has shown the potential of socio-cultural valuation for the (a) identification of a diverse flow of ecosystem services, without fear of double counting (e.g., food is usually considered as one ecosystem service in order to avoid double counting, hence hiding the heterogeneity of sources of food: agriculture, livestock, honey, wild edible plants gathering, hunting, etc.); (b) visibility of socio-cultural preferences at different perception scales (self-oriented or for personal well-being vs. Other-oriented or for social well-being); (c) identification of different needs within different times (i.e., seasons of the year) and spaces (i.e., areas); (d) elucidation of perceived trends as an early warning of ecosystem service deterioration (e.g., fire prevention); (e) possibility of revealing perceived bundles of ecosystem services that can inform management decisions (e.g., links between livestock and connectivity and seed dispersal); (f) exploration of the link between ecosystem services and traditional management practices (i.e., transhumance); and (g) achievement of all of these objectives through relatively inexpensive research, yet using primary data.

Therefore, we propose that the socio-cultural approach for valuing ecosystem services, as related in the foregoing study to a living transhumant social-ecological network, can demonstrate how traditional low-intensity agrarian landscapes are responsible for the delivery of a diverse flow of ecosystem services. This, we believe, should be enough to justify policy interest and institutional support toward their preservation.

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Appendix A

Table A1. Classification of ecosystem services assessed, descriptions, examples and correspondence classification according to Millennium Assessment (MA; description based on de Groot et al., 2002).

Type of ecosystem services	Ecosystem services	Description	Examples	MA
Provisioning	Genetic pool	Genetic material and evolution in animals and plants	Local breeds	Genetic resources
	Gathering	Wild edible plants and mushrooms	Boletus eduli	Food
	Manure	Fertilization of soil for crop production	Use of manure to fertilize home gardens	Biochemicals
	Feed for animals	Cereal crops for animal feeding	Barley, stubble	Food
	Food from hunting	Wild meat	Rabbit meat	Food
	Food from agriculture	Crops for human consumption	Olives, wine, garlic,	Food
	Products from apiculture	Food, medicines and wax produced by bees	Honey, propolis	Food/ Biochemicals
	Fibre	Natural fibres for textiles	Wool	Fibre
	Wood and timber	Forest products used as fuel or as building materials	Holm oak timber	Fuel/Fibre
	Livestock	Food from livestock	Lamb and veal	Food
Regulating	Tree regeneration	Influence of temporal and low stocking grazing (transhumance) in tree regeneration, by helping seeds germination through trampling, and ecosystem structure regeneration by low- pressure browsing	Regeneration of holm oaks in dehesas	-
	Biological control	Population control by trophic-dynamic relations	Insect plague regulation	Pest regulation
	Air purification	Role of ecosystems in bio-geochemical cycles	Clean air	Air quality regulation
	Habitat for species	Provision of suitable living and nursing places for wild species	Rabbits, birds	Provision of habitat
	Fire prevention	Influence of ecosystem structure on reducing frequency and extension of fire events	Consumption of inflammable biomass by herbivores	Natural hazard regulation
	Soil erosion control	Role of vegetation root matrix and soil biota in soil retention	Retention of soil via pasture roots	Erosion regulation
	Connectivity and seed dispersal	Role of ecosystem structure for allowing animal and plant movement and colonisation	Dispersal of pasture species	Seed dispersal
	Maintenance of soil fertility	Accumulation of organic matter and role of soil structure and biota in storage and recycling of nutrients	Trampling by animals	Soil formation

Type of ecosystem services	Ecosystem services	Description	Examples	MA
	Pollination	Role of biota in movement of floral gametes	Pollination	Pollination
	Microclimate regulation	Influence of land cover and biologically mediated processes on climate at local scales	Maintenance of green pasture under forest canopy in summer	Climate regulation
	Hydrological regulation	Role of land cover in regulating the water cycle	Evapotranspiration	Water regulation/ cycling
	Ditch maintenance	Role of animals in the consumption of biomass along road margins (avoiding human work for fire prevention and roads conservation)	Sheep grazing in ditches	-
Cultural	Tranquillity/ relaxation	Influence of ecosystems on human physical and psychological well-being via relaxation activities	Pleasure of walking in the woods	Aesthetic values / Inspiration
	Nature recreation activities	Influence of ecosystem in human well-being through outdoor activities	Horse riding, cycling, hiking	Recreation and ecotourism
	Cultural identity	Variety of natural features that embody or reinforce cultural values	Music, pictures, symbols	Cultural diversity
	Recreational hunting	Influence of ecosystems on human well-being through hunting	Rabbit, partridge	Recreation and ecotourism
	Scientific knowledge	Ecosystem features of scientific value	Research	Knowledge systems
	Environmental education	Ecosystem features of educational value	School visits	Educational values
	Bullfighting events	Role of ecosystems in provision of necessary elements (e.g., landscapes, bulls/cows) for bullfighting events	Local celebrations featuring bulls	Recreation and ecotourism
	Aesthetic value	Attractive landscape features	Pleasure of beautiful views	Aesthetic values
	Way of cultural exchange	Variety in natural features that allow exchange and mutual enriching between human populations	Exchange of recipes	Cultural diversity
	Spiritual value	Natural features with spiritual value	Churches in the Drove Road	Spiritual and religious values
	Local ecological knowledge	Ecosystem features related to locally/traditionally developed knowledge, practices or beliefs	How to shepherd a transhumant herd	Knowledge systems
	Rural tourism	Influence of ecosystems on human well-being through activities related with rurality	Gastronomic tourism	Recreation and ecotourism

Appendix B.

Table B1. Ecosystem service preferences. Importance for social well-being was a mean, calculated according to position in the ranking (1st = 3; 2nd = 2 and 3rd = 1); importance for personal well-being was calculated as the mean score (no importance = 1; little importance = 2; some importance = 3; very important = 4) that interviewees gave an ecosystem service for the satisfaction of their personal well-being. (SD: standard deviation).

		Social well-being		Personal well-being	
Type of ES	**Ecosystem services**	***Mean***	***SD***	***Mean***	***SD***
Provisioning	Genetic pool	2.05	0.73	3.36	0.89
	Gathering	1.74	0.85	3.51	0.89
	Manure	1.67	0.68	2.81	1.08
	Feed for animals	2.00	0.77	3.06	0.97
	Food from hunting	2.00	0.85	3.14	0.66
	Food from agriculture	2.13	0.82	3.50	0.83
	Products from apiculture	1.83	0.75	2.60	1.52
	Fibre	1.73	0.79	2.27	1.35
	Wood and timber	1.33	0.50	2.89	1.05
	Livestock	2.16	0.85	3.03	1.09
Regulating	Tree regeneration	2.12	0.77	3.46	0.92
	Biological control	1.81	0.83	2.88	0.96
	Air purification	2.35	0.77	3.74	0.70
	Habitat for species	2.27	0.74	3.13	1.03
	Fire prevention (natural hazard)	2.25	0.80	3.56	0.87
	Soil erosion control	1.86	0.83	3.67	1.36
	Connectivity and seed dispersal	1.91	0.78	3.15	0.97
	Maintenance of soil fertility	1.71	0.68	3.24	0.92
	Pollination	2.00	0.94	3.19	1.05
	Microclimate regulation	2.06	0.87	3.73	0.52
	Hydrological regulation	2.20	0.42	3.80	0.42
	Ditch maintenance	1.63	0.74	2.50	0.76
Cultural	Tranquillity/relaxation	1.93	0.81	3.46	1.07
	Nature recreation activities	1.75	0.74	2.78	1.17
	Cultural identity	2.03	0.88	3.47	0.73
	Recreational hunting	1.69	0.75	2.62	1.45
	Scientific knowledge	1.67	0.77	3.18	1.01
	Environmental education	1.84	0.81	3.57	0.70
	Bullfighting events	2.00	0.93	3.14	1.21
	Aesthetic value	1.64	0.73	3.30	0.98
	Way of cultural exchange	1.73	0.78	2.86	1.04
	Spiritual value	2.07	0.96	3.40	0.83
	Local ecological knowledge	1.74	0.79	3.18	1.09
	Rural tourism	1.69	0.85	2.62	1.15

Capítulo 4.4

Valorando la percepción de los servicios de los ecosistemas a través de estímulos visuales: el caso de los paisajes culturales de la trashumancia.

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4.4. Exploring social perceptions of ecosystem services in cultural landscapes using visual stimuli: the case of transhumance in Mediterranean Spain

Abstract The ecosystem services approach has been proposed as a powerful tool for the analysis of coupled social-ecological systems. This approach can be particularly useful with regard to cultural landscapes, which are the result of joint evolution of humans and nature across a very long time span. Transhumance, a customary livestock management practice consisting of regular seasonal migration of herds between summer and winter pasturelands, is responsible for the maintenance of unique cultural landscapes in Mediterranean Spain, shaped over many centuries of pastoral activity. Drove roads, used for herd migration, are the most outstanding feature in these landscapes. Here, we used visually based landscape interpretation to evaluate social perceptions of ecosystem services provided by the Conquense Drove Road transhumance landscape (Spain). Face-to-face questionnaires (*N*= 324) were applied to a sample of local inhabitants, visitors and urban people. Questionnaires consisted of two photographic pairs (of cropland and a pine forest), both associated with the transhumance landscape. One photograph in each pair contained a drove road. We compared social perception regarding 16 ecosystem services supplied by these two landscapes and tested the differences between landscapes with/without a drove road. Overall, respondents recognized a higher capacity of forests to deliver a wider range of ecosystem services to society in comparison to croplands: provisioning services are mostly associated with cropland, while regulating and cultural ecosystem services tended to be related to forest. All three types of ecosystem services were more strongly perceived by respondents when a drove road was present in either landscape. However, differences in perception of ecosystem services supply emerged according to certain socio-demographic and cultural respondent characteristics, such as sense of place, relationship with transhumance, environmental attitude, educational level, main occupation, age and gender, as well as preference towards images with a drove road. We describe ecosystem services clusters emerging from the found social perceptions that reveal potential trade-offs resulting from diverging socio-cultural profiles. Finally, we discuss the applicability and usefulness of the proposed approach for evaluating ecosystem services in cultural landscapes and informing policy-making processes.

Key words: visual perception; ecosystem services; Mediterranean landscapes; transhumance; drove road; cropland; pine forest.

4.4.1. Introduction

The study and management of social-ecological systems requires a thorough understanding of the ways societies benefit from nature and, hence, the many reasons why people value the contributions of ecosystems for human wellbeing (Martín-López et al. 2012). Acknowledging the close links between society and ecosystems is particularly critical in places such as the Mediterranean ecoregion, where landscapes are the result of the joint evolution of humans and nature across a long time span. This process has involved the transformation of more natural landscapes into a shifting mosaic of patches, with ecosystems exhibiting different degrees of maturity and human control, ranging between forested areas and intensively used croplands (Forman 1995). Some authors have proposed that Mediterranean landscapes have been "designed" by cultures (Blondel 2006) and that the Mediterranean ecoregion is a cultural landscape in which the relationships between humans and nature have created socio-cultural and ecological patterns and feedback mechanisms of control (Farina 2000, Blondel et al. 2010).

Proper management of Mediterranean cultural landscapes requires a comprehensive analysis of the ecological, social and economic dimensions of coupled social-ecological systems (Garcia-Llorente 2012). The ecosystem services framework has been proposed as a powerful conceptual and analytical approach for such analysis that has been gaining increasing attention in policy and practice (Fisher et al. 2009, Chan et al. 2006, Chan et al. 2011). Likewise, the cultural landscapes framework provides a useful conceptual nexus for the simultaneous analysis of both biophysical and psychosocial phenomena (Selman 2012). These two approaches are strongly linked in terms of their foundations and goals, but have generally been used by quite different scientific groups and disciplines (see Schaich et al, 2010 for further discussion). However, it has been argued that the complementarity of both paradigms, if combined, could offer a window of opportunity to improve the effectiveness of environmental decision-making (Termorshuizen, 2009). In this sense, ecosystem services can be used as a common code to adequately communicate the importance of Mediterranean ecosystems to society, while the cultural and perceptual dimensions of the landscape approach can provide a socially-shared communication channel.

The ecosystem services approach focuses on the contributions of ecosystems to human wellbeing (de Groot et al. 2010). Hence, it has the potential to become an effective common social code for more accurately addressing stakeholder viewpoints and perceptions regarding landscape management options (Menzel & Teng 2010). However, until now, ecosystem services literature has mainly been focused on biophysical analyses of the capability of ecosystems to deliver services or on their economic valuation (Seppelt et al 2011, Vihervaara et al. 2010). Moreover, decision makers have usually mistrusted people's abilities to understand and interpret ecosystem capacities to supply the services they demand (Buchecker 2002, Sevenant 2010). In this regard, many authors have warned that not enough attention is being paid to the values, attitudes and meanings underlying social demands on ecosystem services (Lamarque 2011), beyond monetary estimations (Chan 2012, Martin-Lopez 2012). Hence, there is a need to employ non-monetary methods that can unravel social preferences towards ecosystem services, particularly concerning cultural landscapes (Termorshuizen 2009).

On the other hand, the cultural landscapes approach can provide important insights for finding appropriate communication channels between stakeholders, researchers and decision makers. Landscape have long been considered as the product of multisensory perception of a system of ecological relationships (Bernáldez 1989), with cultural landscapes being seen as socially constructed phenomena, occupying the nexus between biophysical attributes, emotional meanings and human actions (Tuan 1974). Fry et al. (2009) report an overlap between the effects indicated by visual and ecological indicators. The European Landscape Convention (2000) has defined a landscape as "*an area as perceived by people, whose character is the result of the action and interaction of natural and human factors*". Experience of landscapes constitutes the interface of human engagement with the environment (Gobster et al. 2007), and the sense of sight is the tool capturing most of the information that shapes our behaviours and orients our biological adaptation to the environment (Ornstein and Carstensen 1991). This fact turns visually based landscape interpretation into an ideal tool for investigating the human–ecosystem interface and, thus, ecosystem services. Evidence based on visual stimuli has been long used in perception-based methods of landscape research (e.g., Daniel 2001). Much research clearly shows the utility of visual landscape stimuli as a reliable and consistent means for asking members of the public about their attitudes towards ecosystems (Daniel 2001), and specifically in the Mediterranean context (Arriaza 2004, Surová and Pinto-Corregia 2008).

However, as far as we know, apart from assessment of landscape aesthetic qualities or cultural values, perception-based methods have not been used yet to evaluate people's awareness of ecosystem services associated with particular landscapes. We hypothesize that, when presented with landscape visual stimuli, people can identify the services potentially delivered by ecosystems in a given landscape. Here, we explore the use of pair-wise photographs as visual stimuli to evaluate social perceptions of ecosystem services in cultural landscapes, using a transhumance cultural landscape (Herzog et al. 2005) in Mediterranean Spain as a case study.

Our specific objectives in this paper are to: (a) compare ecosystem services perception using visual stimuli from two different cultural landscapes associated with transhumance: a pine forest landscape from a summering pasture area and a cropland landscape crossed by a drove road; (b) compare visual perception of ecosystem services between landscapes with and without the presence of a drove road; (c) explore the underlying demographic, socio-cultural and attitudinal factors influencing social perception of ecosystem services in transhumance cultural landscapes; and (d) identify and describe ecosystem service clusters emerging from social perceptions, seeking to uncover potential trade-offs resulting from diverging socio-cultural profiles. Finally, we discuss the applicability and interest of the proposed methodological approach for evaluating ecosystem services in cultural landscapes and for informing policy making.

4.4.2. Study area and methods

4.4.2.1.The transhumance cultural landscape of the Conquense Drove Road

Transhumance is a customary livestock management practice that consists of regular seasonal migration of herds between summer pastures (highlands, usually in northerly latitudes) and winter pastures (lowlands, in southerly latitudes), in order to match grazing pressure with seasonal peaks in pasture availability (Ruiz and Ruiz 1986). This practice is responsible for the maintenance of the so called “transhumance cultural landscapes” that have been shaped over many centuries of pastoral activities and the adaptation of herders’ practices to a harsh and highly fluctuating environment (Herzog et al. 2005). The managed cultural landscapes maintained by transhumant livestock have been widely acknowledged for providing important ecosystem services such as fire prevention, maintenance of soil fertility, landscape connectivity and habitat for species, traditional ecological knowledge, cultural identity, food, and genetic pool maintenance (e.g. Bunce et al. 2004, Oteros-Rozas et al. 2012a).

Within transhumance cultural landscapes, drove roads are the most outstanding and characteristic landscape feature. The network of transhumance drove roads in Spain – granted legal protection since 1995 (Drove Roads Act) – is formed by a mix of Royal Drove Roads (*cañadas reales*), whose legal width is about 75 m, and smaller trails known as *cordeles* (approx. 37 m wide) and *veredas* (approx. 20 m). The whole network extends over roughly 125,000 km, occupying about 422,000 ha (0.8% of the country; Merino and Alier 2004).

Our research was conducted at the Conquense Drove Road (CDR), one of the largest drove roads still used by Spanish herders to move cattle and sheep on foot (Fig.4.4.1). We have previously approached this cultural landscape as a social-ecological network (*sensu* Jansen et al. 2006) of biophysical and social flows generated and maintained by the movement of herders and livestock and comprising the summering and wintering pasturelands as well as the drove roads linking them together with the associated social capital elements (Oteros-Rozas et al. 2012a).

The summering area of the CDR is characterized by semi-deciduous and coniferous forests (mostly pine plantations), mixed with patches of fodder crops, located in the eastern part of the Montes Universales (Teruel, Guadalajara, and Cuenca provinces). The winter pasturelands are more spatially dispersed throughout southeastern Sierra Morena and southern La Mancha*,* (Jaen and Ciudad Real provinces), mostly consisting of Mediterranean *dehesas,* i.e. agrosilvopastoral systems mainly aimed at extensive livestock grazing but from which crops and non-timber forest products are also obtained. Finally, the drove road linking both areas consists of a 75 m wide and approximately 410 km long corridor crossing predominantly cultivated areas (mostly vineyards, sunflowers, cereals, and olive groves).

According to official livestock-movement permits granted since 2009, a total of 87 shepherds have been transhumant in the study area. However, most of them currently use trucks to move their livestock, with only 15 herders, possessing altogether almost 9,000 ovine heads and 1,200 cows, still walking the drove road to move between summering and wintering pasturelands (Oteros-Rozas et al. 2012b).

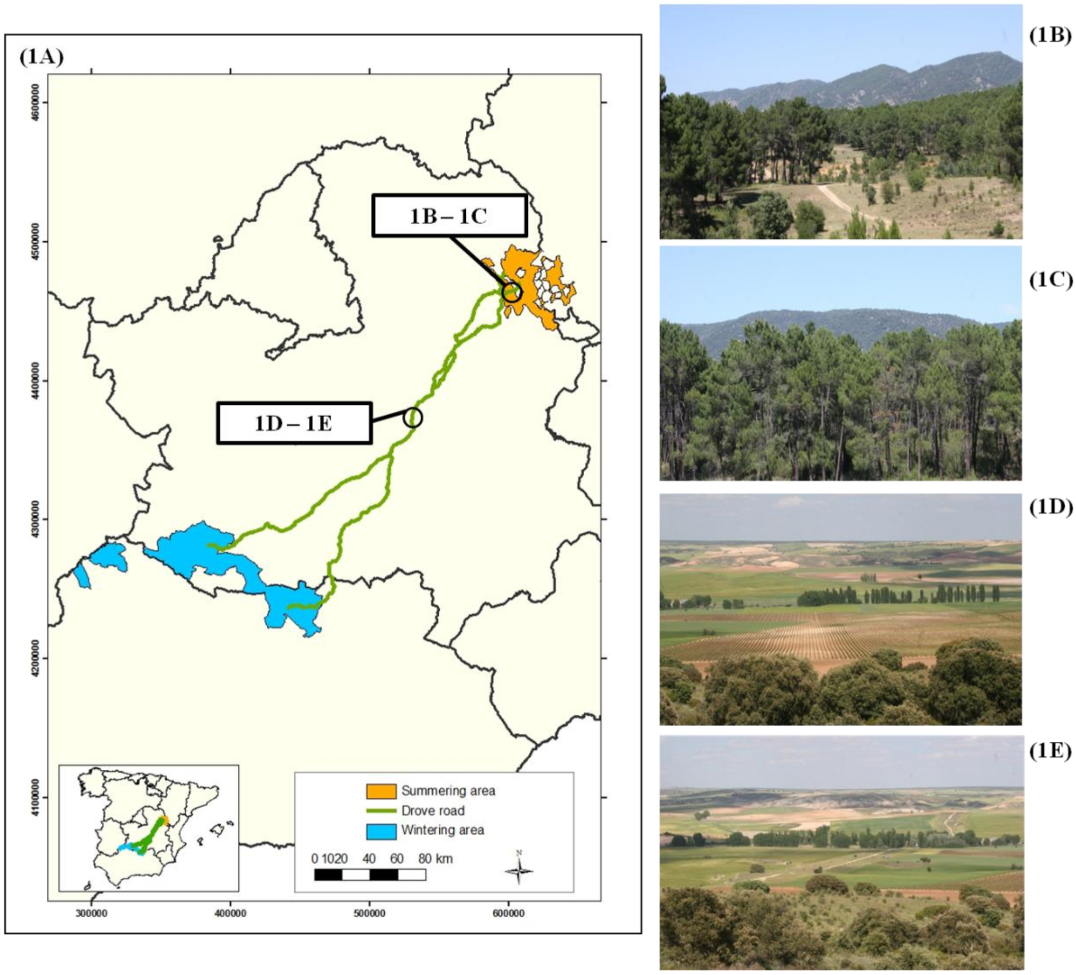

Figure 4.4.1. Map of the study area with the Conquense Drove Road (green) and the related summering (yellow) and wintering (blue) areas. The two pairs of images used for the evaluation of the ecosystem services provision: forest landscape without the drove road (A), forest landscape with the drove road (B), cropland landscape without the drove road (C) and cropland landscape with the drove road (D).

4.4.2.2.Data collection

Data was obtained through 324 face-to-face questionnaires conducted from August to November 2010 in 23 municipalities within the range of the drove road. Questionnaires were pretested on a small sample population, to test wording and overall understanding before being administered. The sample population was restricted to individuals older than 18 years and was representative of the main users and beneficiaries of ecosystem services previously characterized in this landscapes (Oteros-Rozas et al. 2012a). The sample included mostly local inhabitants (54 herders, 64 farmers, and 67 from other professions), but also visitors/tourists to the drove road area (*N*= 38) as well as urban people not familiar with the study area (*N* = 34), and scholars and students of landscape and environmental sciences (*N* = 57).

The questionnaire was designed to assess the visual perception of ecosystem services in landscape photographs (see García-Llorente et al. 2012 for similar methodological approaches). All respondents were given a brief explanation regarding the study area and the ecosystem services concept, understood as "the benefits that ecosystems provide for human well-being" (MA, 2005). The ecosystem services selected (see Appendix B) for the perception exercise had been identified and described by previous research in the study area (Oteros-Rozas et al., 2012a). Visual perception of ecosystem services in the studied landscapes was assessed using two original, unmanipulated pairs of photographs: the first pair represented the pine forest landscape of the Serranía de Cuenca (Fig.4.4.1, pictures A and B) while the second one stood for the cropland landscape of La Mancha (Fig.4.4.1, pictures C and D). In each pair, both images were very similar, except for the fact that a drove road was present in one of them (Fig.4.4.1, pictures B and D) and absent in the other one (pictures A and C).

Respondents were asked to score the degree of provision of each ecosystem service from one (minimum) to four (maximum), according to the following question: "To what extent do you perceive that the landscape in the photograph is delivering each of the listed ecosystem services". Two questionnaires' models, each with a list of ecosystem services in a different order from the other, were used in order to avoid position bias (Bateman et al. 2002). Sixteen ecosystem services were selected for the evaluation, according to previous research in the study area (Oteros-Rozas et al., 2012a, Oteros-Rozas et al., 2012b). Five of these were classified as provisioning (feed for animals, gathering, food from agriculture, wood and timber and livestock), five as cultural (aesthetic values, cultural identity, tourism, hunting and tranquillity/relaxation) and six as regulating services (air purification, plant regeneration, fire prevention, soil erosion control, habitat for species and connectivity).

Questionnaires also included a set of questions regarding some socio-demographic characteristics of informants (e.g., age, gender, place of residence) and their environmental awareness/attitudes (e.g., readers of environmental publications, members of environmental association, rural sense of place) (see Appendix A). Ten questionnaires were incomplete and, thus, removed from the sample (final *N*= 314).

4.4.2.3.Data analysis

Comparison of perceptions regarding ecosystem services in cropland and pine forest landscapes (objective one) was carried out with the data set obtained only via the photographs without a drove road. For comparison of ecosystem service perceptions in landscapes with and without a drove road (objective two), we separately used the data from the pair of photographs in cropland and the pair of photographs from the pine forest. Descriptive statistics (mean frequencies and correspondent standard deviations) and Wilcoxon rank-sum tests were performed for the three cases, in order to identify and describe differences in ecosystem service perceptions between the cropland and the pine forest landscapes (objective one) and between the landscapes with and without a drove road (objective two).

To accomplish the third objective, that is, the exploration of how underlying socio-demographic factors may influence the perception of ecosystem services, we applied a redundancy analysis (RDA) for each landscape (cropland and pine forest). We performed Monte Carlo permutation tests (1,000 permutations) for determining the significance of independent variables in influencing the perception of ecosystem services. The most important variables in terms of socio-cultural perception were identified on the basis of the values of inertia of the factors.

Groups of ecosystem services were identified (objective four) by performing a hierarchical cluster analysis (HCA) with the scores of these factors. We utilized only the factors that account for more than 80% of variance, and we used the Bray Curtis distance and Ward's method as agglomerative techniques (Ward, 1963).

4.4.3. Results

4.4.3.1.Comparison of perceived ecosystem services provision in cropland and forest landscapes

Overall, air purification, aesthetic value and tranquility/relaxation exhibited the highest scores in both croplands and forests, while feed for animals, gathering, livestock and connectivity were the lowest identified by respondents. However, the mean scores of all perceived ecosystem services were significantly different between the cropland and forest ecosystems, except for cultural identity (Wilcoxon tests; *p*-value < 0.001; Fig.4.4.2).

In general, forest landscapes scored significantly higher values as supplying ecosystem services than croplands, except for most of the provisioning services (i.e., feed for animals, food from agriculture, and livestock) and fire prevention and connectivity. The strongest differences in the perceived delivery between the two landscapes were food from agriculture, associated with the cropland landscape, and wood and timber, clearly perceived in the forest landscape.

According to the main categories of ecosystem services, provisioning services were mostly associated with the cropland landscape (9% more than forest), while regulating and cultural ecosystem services were more highly linked to the forest landscape (12% and 15% more than cropland, respectively).

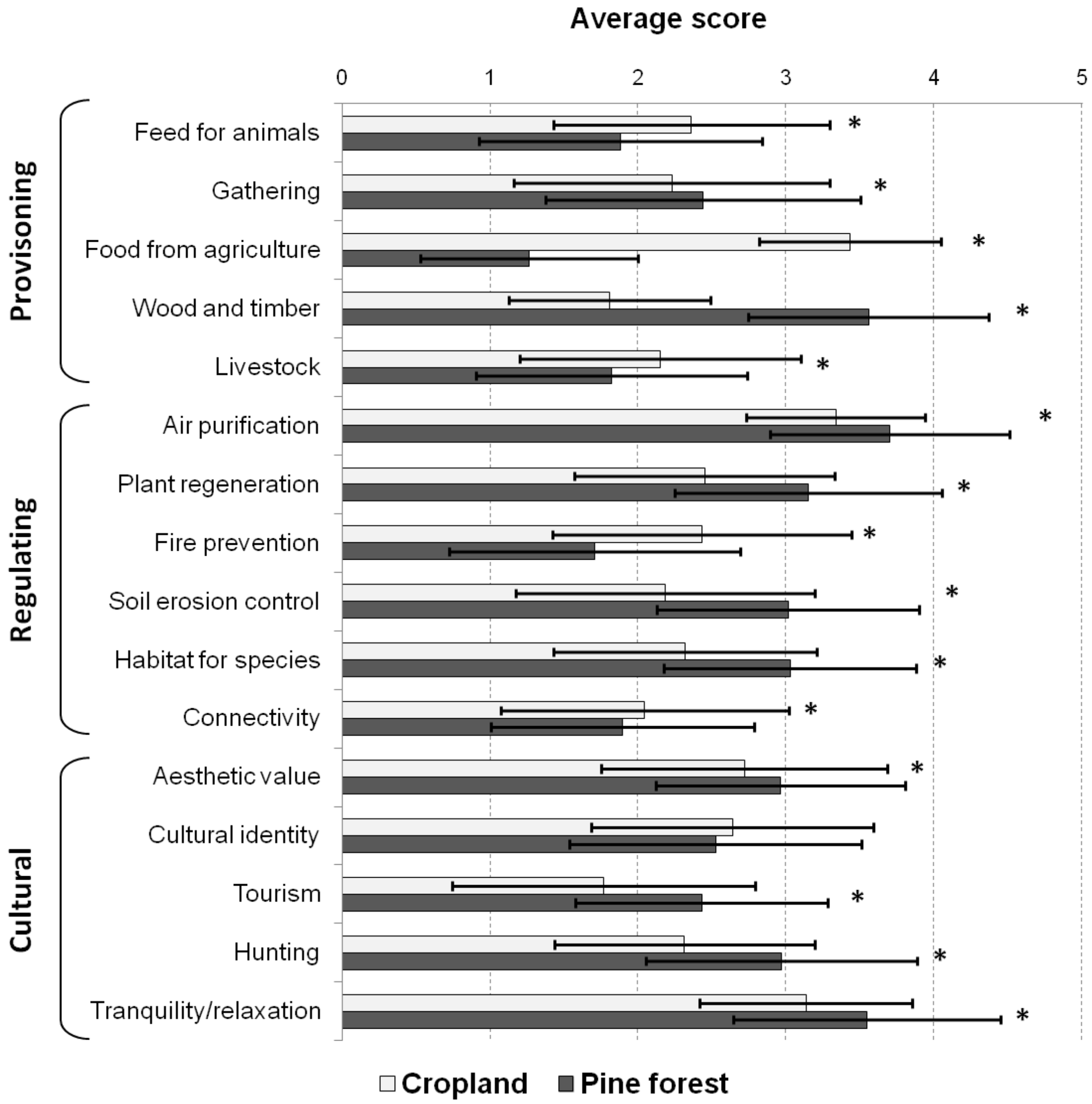

Figure 4.4.2. Average scores (and standard deviation) of the perception about the capability of cropland and forest to deliver ecosystem services. Asterisks show significant differences between cropland and forest ecosystems on the basis of the Wilcoxon test (*p*-value < 0.001).

4.4.3.2. Effect of the drove road on ecosystem services perception

All three types of ecosystem services, both in the cropland and in the forest landscapes, were significantly more greatly perceived by respondents as being provided when a drove road was present in the picture (Table 4.4.1). Particularly provisioning services were scored 11% and 6% higher with a drove road in the forest and cropland landscapes, respectively, in comparison to their pairs lacking this feature; regulating services were 5% and 13% higher in the forest and cropland landscapes with a drove road, and cultural services were also scored higher in the forest (7%) and cropland (10%) landscapes with a drove road (Wilcoxon tests; *p*-value<0.001).

Table 4.4.1. Comparison of ecosystem services perceptions in both landscapes (croplands and pine forests) with and without the drove road based on the paired Wilcoxon signed-rank test. Mean scores (and standard deviation between brackets) are also shown. Significant at * *p*-value < 0.1, ** *p*-value < 0.05, *** *p*-value < 0.01.

Ecosystem Services	CROPLAND					PINE FOREST				
	No drove road		Drove road		V	No drove road		Drove road		V
	Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.	
Provisioning	2.40	0.55	2.55	0.57	9695.5***	2.19	0.52	2.43	0.52	23878.0***
Feed for animals	2.36	0.95	3.00	0.83	2945.5***	1.88	0.93	2.64	0.95	19561.0***
Gathering	2.23	1.06	2.33	0.93	5862.0**	2.44	1.07	2.47	0.96	3775.5
Food from agriculture	3.43	0.73	2.55	0.95	22452.0***	1.26	0.62	1.47	0.78	1850.0***
Wood and timber	1.81	0.81	2.00	0.91	1428.5***	3.56	0.68	3.01	0.86	655.0***
Livestock	2.15	0.91	2.85	0.93	1477.0***	1.82	0.95	2.57	0.98	17488.0***
Regulating	2.46	0.52	2.78	0.52	3786.0***	2.75	0.49	2.95	0.49	26611.0***
Air purification	3.33	0.80	3.44	0.67	735.0***	3.70	0.60	3.55	0.71	556.5***
Plant regeneration	2.45	0.90	2.77	0.90	1872.0***	3.15	0.88	3.10	0.75	4845.5
Fire prevention	2.43	0.98	2.43	0.94	5130.0	1.70	1.01	2.49	1.01	19525.5***
Soil erosion control	2.18	0.88	2.45	0.92	2109.0***	3.01	1.01	2.69	0.90	3162.5***
Habitat for species	2.32	0.85	2.70	0.85	1953.0***	3.03	0.89	2.97	0.81	3896.0
Connectivity	2.04	0.89	2.89	0.83	1494.0***	1.89	0.97	2.91	0.81	25336.5***
Cultural	2.51	0.52	2.75	0.56	7519.0***	2.89	0.62	3.02	0.56	18616.0***
Aesthetic	2.72	0.84	2.88	0.7	7309.0*	2.96	0.9	3.24	0.80	14745.0*

values				9			6			**
Cultural identity	2.64	0.98	2.66	0.95	6438.5	2.52	0.95	2.78	0.90	9599.5***
Tourism	1.77	0.85	2.19	0.99	1010.0***	2.43	1.02	2.77	0.95	8584.0***
Hunting	2.31	0.92	2.68	0.89	1422.0***	2.97	0.88	2.92	0.83	3432.5
Tranquillity / relaxation	3.13	0.90	3.35	0.76	1324.5***	3.54	0.72	3.38	0.83	1749.0***

In the cropland landscape, all ecosystem services exhibited higher scores in the photographs where a drove road is present than in the correspondent pair, except for food from agriculture – which appears to be more often perceived as being delivered in the absence of a drove road – and fire prevention and cultural identity, for which no statistically significant differences were obtained (Table 4.4.1). In the forest landscape, four ecosystem services did not register significant differences between the photograph with a drove road and its pair without this element: gathering, plant regeneration, habitat for species and hunting. Three ecosystem services were considered to be provided to a greater extent by the forest landscape without the drove road: wood and timber, air purification and soil erosion control. Respondents considered that, for the rest of ecosystem services, the forest with a drove road was supplying them to a greater extent than if there had been no such feature (Table 4.4.1).

4.4.3.3.Identifying clusters of ecosystem services based on socio-demographic factors behind social perceptions

Factors influencing ecosystem services perception in croplands

The RDAs indicate a significant association between stakeholder characteristics and how they perceive ecosystem services supply in both cropland (*p*-value < 0.0001, from 1,000 permutations) and forest cultural landscapes (*p*-value < 0.0001, from 1,000 permutations).

The first five axes of the RDA performed for the case of croplands explained 82.9% of the total variance (Table 4.4.2). The first axis accounted for 37.9% of total variance and the main explanatory variable was a preference for the landscape with the drove road (negative side) or without it (positive side). Women and local residents from La Mancha tended to be more associated with non-preference for the road and with higher scores for aesthetic values, tranquillity/relaxation, air purification, gathering, wood and timber, habitat for species and plant regeneration in the landscape without the road. People who had environmental sciences education/training and read environmental publications, together with herders and those aged people who have had experience with transhumance, mostly perceived livestock, connectivity, cultural identity and tourism in the image with a drove road.

Table 4.4.2. Redundancy analysis results for cropland landscape, showing the factor scores of ecosystem services and the variables related to respondents' socio-economic characteristics. Eigenvalues, percentage of variance explained (%), cumulative percentage of variance explained and inertia by axes (1–5) are also indicated. Bold values indicate those variables with the largest squared cosine in each of the axes.

ECOSYSTEM SERVICES	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5	
	No D.R.	D.R.	No D.R.	D.R.	No D.R.	D.R.	No D.R.	D.R.	No D.R.	D.R.
Feed for animals	0.34	0.03	0.25	0.21	-0.07	-0.12	-0.09	-0.03	0.16	-0.15
Gathering	0.43	0.07	-0.22	0.11	0.11	-0.01	-0.06	0.03	0.01	-0.20
Food from agriculture	0.00	0.01	-0.01	0.40	-0.24	-0.01	-0.07	-0.36	0.12	0.28
Wood and timber	0.56	0.55	-0.13	-0.07	-0.09	-0.08	-0.05	-0.06	-0.09	-0.14
Livestock	0.25	-0.18	0.25	0.42	0.06	0.02	-0.01	0.01	0.14	-0.03
Air purification	0.44	0.30	-0.18	-0.03	-0.01	-0.05	-0.04	-0.03	-0.08	-0.13
Plant regeneration	0.76	0.36	0.13	0.25	-0.04	-0.17	0.12	0.03	0.00	-0.20
Fire prevention	-0.21	-0.11	0.04	0.10	-0.02	-0.11	0.38	0.31	0.01	0.23
Soil erosion control	0.30	-0.02	0.23	0.19	0.01	-0.18	0.27	0.34	-0.02	-0.04
Habitat for species	0.39	0.01	0.07	0.11	0.10	0.00	0.11	0.09	0.05	-0.05
Connectivity	0.11	-0.13	0.10	0.40	0.07	-0.20	0.04	-0.01	0.02	0.09
Aesthetic values	0.58	-0.03	0.18	0.38	0.08	-0.09	0.15	-0.11	0.28	-0.10
Cultural identity	0.30	-0.18	-0.09	0.35	0.47	0.21	0.12	0.02	0.04	-0.22
Tourism	0.30	-0.18	0.21	0.46	0.05	-0.03	-0.04	-0.04	0.02	-0.14
Hunting	-0.03	-0.01	0.22	0.21	0.47	0.41	-0.12	0.04	0.06	-0.14
Tranquillity/relaxation	0.55	0.23	-0.05	0.19	-0.10	-0.07	-0.13	-0.10	-0.02	-0.07
RESPONDENT'S CHARACTERISTICS										
Studies Level	-0.06		-0.20		-0.16		-0.11		0.02	
Visit frecuency	-0.25		0.14		0.16		-0.17		-0.02	
Environmental reader	-0.32		-0.02		0.05		-0.08		0.04	
Age	-0.13		0.17		0.17		0.23		-0.03	
Serranía residents	-0.06		0.30		-0.03		-0.11		0.08	
La Mancha residents	0.17		0.01		0.13		0.16		0.00	
Rural	-0.12		0.27		-0.08		0.12		0.12	
Semirural	0.11		-0.09		0.25		-0.06		-0.05	
Urban	0.03		-0.18		-0.12		-0.07		-0.07	
Rural sense	-0.13		0.07		0.20		0.04		0.05	
Experience with transhumance	-0.29		0.15		0.04		-0.03		-0.06	
Gender-male	-0.28		-0.08		0.15		0.07		0.08	
Gender-female	0.28		0.08		-0.15		-0.07		-0.08	
Environmental education	-0.32		-0.08		-0.02		-0.08		0.12	
Herders	-0.21		0.24		0.00		-0.06		-0.01	

Farmers	0.09	-0.05	0.15	0.17	0.08
No Drove Road Preference	0.34	-0.01	0.09	0.04	0.15
Drove Road Preference	-0.34	0.01	-0.09	-0.04	-0.15
RDA STATISTICS					
Eigenvalue	0.93	0.48	0.26	0.21	0.16
Variance exp (%)	37.91	19.53	10.72	8.39	6.36
Cumulative%	37.91	57.43	68.16	76.54	82.90
Total inertia	3.68	1.89	1.04	0.81	0.62

The second axis (19.5% of total variance) revealed a dichotomy between rural and urban respondents. The positive side was associated with rural people, residents in the pine forest summering area, herders, older people, or those who have had experience with transhumance. These respondents tended to mostly perceive food from agriculture, livestock, connectivity, tourism, aesthetic values and cultural identity in the landscape with drove road. The negative side was associated with urban people, who tended to attribute more ecosystem services to landscapes without drove road.

A particular version of the rural–urban dichotomy arose again in the third axis (10% of total variance), where semirural people, living in small cities (Appendix A) of the La Mancha area, mostly older farmers, were associated with the positive side, hence with a greater perception of cultural identity in the image without drove road, as well as a marked perception of hunting in both landscapes with and without drove road. The fourth and fifth axes (8.4% and 6.4% of variance, respectively) revealed again the two basic dichotomies: rural–urban in the fourth and drove road preference in the fifth.

Using these five axes in the HCA, we identified three groups of ecosystem services (Fig.4.4.3A). The first cluster included most of the ecosystem services in the image without the drove road, the second cluster grouped cultural identity and hunting, both in the images with and without the drove road, and the third cluster comprised most of the ecosystem services in the image with drove road.

Factors influencing perception of ecosystem services in pine forests

The first five axes of the RDA performed for the pine forest case explained 82.9% of the total variance (Table 4.4.3). Similarly to the cropland landscape, the first axis (28.6% of the total variance explained) reveal the dichotomy of ecosystem service perception in terms of preferences toward the landscape with the drove road versus without it. The positive loadings of this axis show that youngsters and people with higher levels of education preferred landscapes without drove road, in which they perceived the aesthetic values of a landscape, tourism, tranquility/relaxation, air purification, plant regeneration and habitat for species as well as wood an timber in both types of images (i.e., with and without drove road). In contrast, the negative loadings of this axis were associated with herders and other rural people, who expressed a clear drove road preference and scored higher for livestock when drove road was present.

Table 4.4.3. Redundancy analysis results for pine forest landscape, showing the factor scores of ecosystem services and the variables related to respondents' socio-economic characteristics. Eigenvalues, percentage of variance explained (%), cumulative percentage of variance explained and inertia by axes (1–5) are also indicated. Bold values indicate those variables with the largest squared cosine in each of the axes.

ECOSYSTEM SERVICES	AXIS 1		AXIS 2		AXIS 3		AXIS 4		AXIS 5	
	No D.R.	D.R.	No D.R.	D.R.	No D.R.	D.R.	No D.R.	D.R.	No D.R.	D.R.
Feed for animals	-0.04	-0.23	-0.09	-0.41	0.38	0.21	0.00	-0.05	0.21	0.17
Gathering	0.19	-0.12	-0.51	-0.49	-0.10	-0.03	-0.02	-0.07	0.19	0.11
Food from agriculture	0.04	-0.09	0.07	0.14	0.19	0.25	0.02	0.02	0.08	-0.06
Wood and timber	0.35	0.51	0.00	-0.04	0.07	0.15	-0.13	-0.43	0.04	0.03
Livestock	-0.17	-0.37	-0.25	-0.44	0.13	0.05	0.24	0.24	0.17	-0.14
Air purification	0.30	0.30	-0.04	-0.04	-0.04	0.10	-0.04	-0.16	0.11	-0.04
Plant regeneration	0.43	0.12	-0.07	-0.12	0.09	0.08	-0.03	-0.13	0.01	0.02
Fire prevention	-0.24	-0.29	0.13	-0.33	0.54	0.21	0.11	0.14	0.00	-0.04
Soil erosion control	0.08	-0.06	-0.34	-0.31	-0.36	-0.10	0.16	0.00	0.15	0.17
Habitat for species	0.41	0.13	-0.18	-0.28	-0.01	-0.04	0.02	-0.20	-0.04	-0.02
Connectivity	0.05	-0.23	-0.19	-0.38	-0.16	-0.01	0.20	-0.19	-0.20	-0.12
Aesthetic values	0.75	-0.01	0.10	-0.16	0.12	0.18	0.42	-0.27	-0.06	-0.24
Cultural identity	0.34	-0.17	-0.23	-0.38	0.25	0.16	0.29	-0.12	-0.03	-0.11
Tourism	0.44	-0.01	-0.34	-0.48	0.03	-0.04	0.23	-0.09	-0.12	-0.24
Hunting	0.18	0.13	-0.16	-0.25	0.19	-0.13	-0.04	0.02	0.01	0.04
Tranquillity/relaxation	0.27	0.29	-0.04	-0.09	0.01	0.04	0.06	-0.25	-0.04	0.04
RESPONDENT'S CHARACTERISTICS										
Studies Level	0.31		-0.08		-0.20		-0.19		0.02	
Visit frecuency	-0.10		-0.17		0.09		0.02		-0.06	
Environmental reader	-0.03		-0.15		-0.16		0.05		-0.09	
Age	-0.31		-0.08		-0.07		0.25		0.00	
Serranía residents	-0.09		-0.11		0.19		-0.11		-0.10	
La Mancha residents	-0.03		0.07		-0.01		0.05		0.12	
Rural	-0.26		-0.12		0.10		-0.07		0.14	
Semirural	0.09		0.13		-0.04		0.02		-0.14	
Urban	0.18		0.02		-0.06		0.05		-0.03	
Rural sense	-0.14		-0.01		-0.04		-0.09		-0.07	
Experience with transhumance	-0.11		-0.17		-0.07		-0.06		-0.09	
Gender-male	-0.20		0.08		-0.15		0.09		-0.08	
Gender-female	0.20		-0.08		0.15		-0.09		0.08	

Environmental education	0.11	-0.26	-0.16	0.02	-0.08
Herders	-0.26	-0.11	0.15	-0.11	-0.12
Farmers	-0.04	0.13	-0.11	0.06	0.12
No Drove Road Preference	0.33	0.02	0.00	0.29	0.04
Drove Road Preference	-0.33	-0.02	0.00	-0.29	-0.04
RDA STATISTICS					
Eigenvalue	0.71	0.64	0.30	0.29	0.13
Variance exp (%)	28.59	25.66	11.95	11.54	5.14
Cumulative%	28.59	54.25	66.20	77.74	82.88
Total inertia	2.88	2.58	1.20	1.16	0.52

The second axis (25.7% of total variance) reflected the differentiated perceptions of semirural farmers from the cropland area (positive loadings), who perceived agriculture as a service when drove road come into view in the image. To the contrary, negative loadings were associated with people that had environmental education and readers of environmental publications as well as those people with transhumance experience. Such people tended to perceive regulating services (i.e., soil erosion control, fire prevention, habitat for species and connectivity) and certain cultural services (i.e., tourism and cultural identity) in the image with drove road. They also strongly perceived gathering as a service provided by pine forests, either with drove road or without drove road.

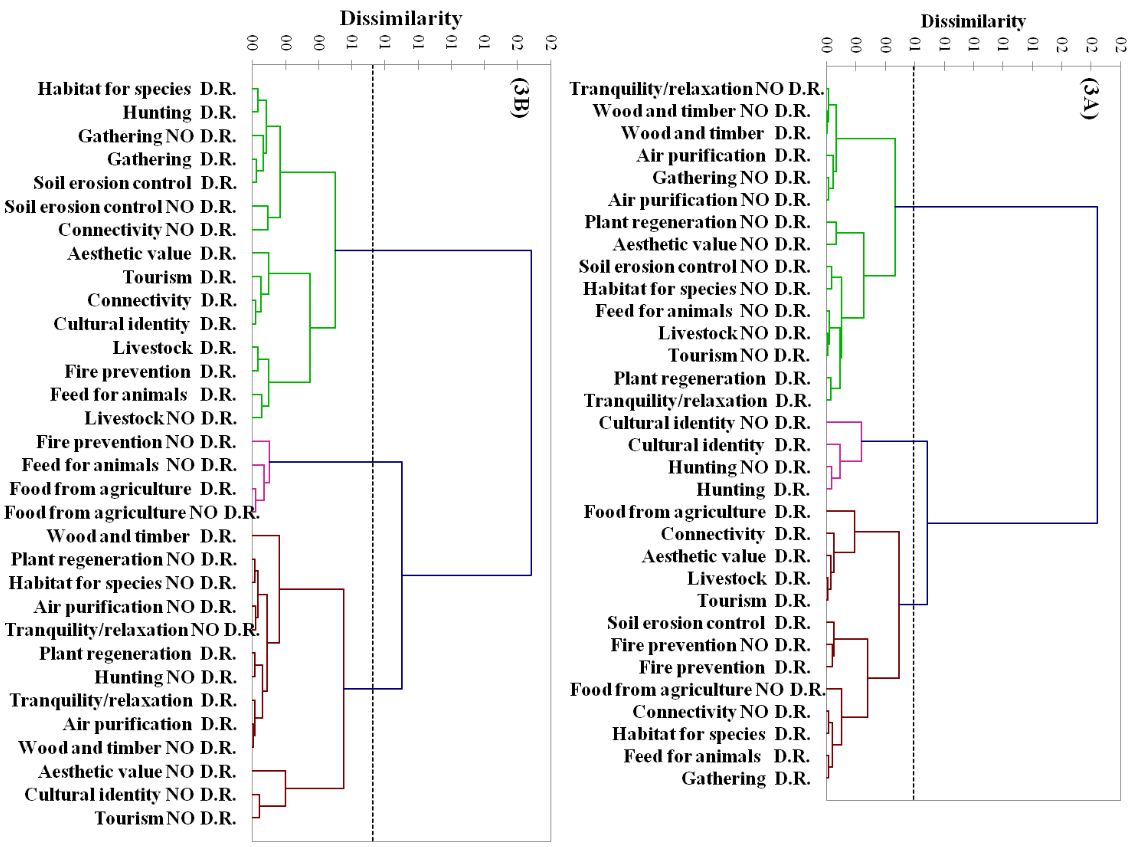

Figure 4.4.3. Dendrograms resulting from the Hierarchical Cluster Analysis (HCA) of those factors of the redundancy analysis (RDA) that accomplish for more than 80% of the variance in the cropland (3A) and the forest (3B) pairs of images. "D.R." refers to the pictures where the drove road is present and "No D.R." to the images where the drove road is not present.

The third axis (12% of total variance) distinguished between residents of the pine forest area, women and herders (in the positive scores) and people with environmental education (in the negative scores). Positive loadings were also related to perception in the image without drove road of fire prevention and feed for animals, as well as food from agriculture in both landscapes. Negative loading were associated with perception of soil erosion control when drove road does not come into sight. The fourth and fifth axes (11.5% and 5.1% of total variance, respectively) were again versions of the preceding dichotomies.

Three groups of ecosystem services were identified in the HCA performed with the five axes obtained by the RDA (Fig.4.4.3B). The first cluster included most of the ecosystem services in the image with the drove road, the second cluster comprised several ecosystem services in the landscapes without drove road and the third cluster grouped fire prevention and feed for animals in the images without drove road and food from agriculture in both landscapes.

4.4.4. Discussion

4.4.4.1. Forests vs. croplands as providers of ecosystem services

The results of our experiment on perception of ecosystem services through photographs suggest that people recognized a greater capacity of forests to deliver a wider range of ecosystem services to society in comparison to croplands, which is consistent with previous results (Harrison et al. 2010, EME 2011). The better social visibility of forest ecosystems as providers of ecosystem services has already been acknowledged (Martín-López et al. 2012) and was evident in this case as well. The classical trade-off between provisioning and regulating or cultural services in agroecosystems (Gordon et al. 2010) was corroborated by respondents perceiving that the cropland landscapes of La Mancha supply more provisioning services, such as agriculture, feed for animals and livestock, while potentially jeopardizing provision of regulating and cultural services. Contrarily, forests are perceived as maintaining a greater ability to supply most of the regulating services and cultural services, such as hunting, tourism, tranquility and aesthetic values. The high perception of aesthetic values in forests may possibly be explained by the phenomenon of phytofilia, through which people tend to prefer green-and-healthy forested views (Ulrich 1986, Ulrich 1990, López-Santiago 1994, López-Santiago et al. 1994) and to appreciate arid landscapes less than forested ones (De Lucio 1994).

In contrast to several previous studies that had reported prominent social perception of provisioning services in comparison to regulating and cultural services (Agbenyega et al. 2009, Hartter 2010, Iftekhar and Takama 2007), our results indicate that both cultural and regulating services are more strongly perceived in both landscapes than provisioning services. This result has also previously been found in other studies about socio-cultural perceptions of ecosystem services in Mediterranean landscapes (García-Llorente et al. 2012). Hence, we can hypothesize that, in cultural landscapes such as the Mediterranean ecosystems, human–nature co-evolution may be the core factor explaining high perception of cultural and regulating services.

4.4.4.2.The drove road as a diversifying landscape feature

Our results show that landscapes with a drove road are perceived by people as being providers of a larger and more varied ecosystem services flow in comparison to landscapes where this element is absent. Drove roads are an example of the influence of herbivorous mammal populations on the physical structure of habitats, either through ecological engineering (Jones et al. 1994) or though ecological landscaping (Sinclair et al. 2003). These effects involve generation of spatial heterogeneity and biodiversity conservation (Coughenour 2007), which is strongly associated with high delivery of ecosystem services (e.g., Díaz et al. 2006; Cardinale et al. 2012; Schneiders et al. 2012). The role of drove roads as a key landscape element for promoting a diverse flow of ecosystem services to society has also been recognized (Oteros-Rozas et al. 2012b). However, to our knowledge, the present study is the first to prove that drove roads are effectively recognized by people as a distinct visual landscape element responsible for the provision of a diversified flow of ecosystem services.

Certain ecosystem services –such as feed for animals, livestock, and connectivity in both landscapes, and fire prevention, particularly in forests– are more sensitively perceived when a drove road becomes visible in the images (Table 4.4.1). This result is consistent with previous studies on the socio-cultural valuation of transhumance-related ecosystem services (González et al., 2012) as well as with the proven ecological role of drove roads for connectivity (Bunce et al. 2006, Manzano and Malo 2006).

We believe that, in the context of Mediterranean landscapes the drove road is probably being perceived by people as evidence of so-called landscape multifunctionality. However, and particularly in Spain, cultural landscapes have been subject to two different and opposed lands-use changes, namely intensification and abandonment, that involve loss of multifunctional landscapes and deterioration of ecosystem services (EME 2011; García-Llorente et al. 2012). On one hand, agricultural intensification in fertile areas has led to a situation where landscapes primarily managed for the supply of one single service (mainly food provisioning), needed to sustain a growing urban population, has done so at the expense of many other cultural and regulating services. On the other hand, rural abandonment of less productive and remote areas, triggered by a lack of social services and market globalization, has produced "rewilded" landscapes, where the supply of cultural services demanded by urban inhabitants (mostly recreational activities and biodiversity conservation) and regulating services are enhanced (EME 2011, Martín-López et al. 2012). Peasant multifunctional management models associated with low-impact agrarian practices such as transhumance have been acknowledged as important assets for the preservation of cultural landscapes and their delivery of a wide range of ecosystem services (Harrop 2007, García-Llorente et al. 2012).

4.4.4.3.Factors influencing social perception of ecosystem services emerging from visual stimuli of cultural landscapes

As our results indicate, perception of ecosystem services differs according to socio-demographic factors and individual backgrounds (e.g., Lamarque et al. 2011, Martín-López et al. 2012, Plieninger et al. in press). Different user groups have exhibited differences in terms of the aesthetic rating of environmental development plans depending on user background (van den Berg et al. 1998) and environmental value orientations (Kalterborn and Bjerke 2002). In this case, the perceived ecosystem services supplied by each cultural landscape are clearly associated with certain socio-demographic and cultural characteristics of stakeholders, but they also appear to be strongly connected with personal preferences towards the images with a drove road. Very similar clusters of ecosystem services have been obtained from the two landscapes explored, associated with analogous respondent profiles. We have identified four stakeholder profiles, each with particular characteristics, perceptions and potential worldviews, as discussed below.

Transhumant cultural identity

Both in the cropland and forest experiments, a group emerged that was particularly attracted by the landscape with a drove road. This group is formed by herders and locals living in small villages of the summering area, having a strong sense of place and knowledge about pastoralism and transhumance. Soini et al. (2012) identify awareness and familiarity with local surroundings as important determinants of landscape perception. This groups is quite representative of the population in the summering area, that has particularly suffered the well documented process of ageing, depopulation (e.g., Pinilla Navarro 1996; Gutman 2007) and masculinization (e.g., MARM 2011; Camarero and Sampedro 2008) that has occurred in rural areas during the last few decades, from the regional to the European scale. Such stakeholders perceive a greater delivery of ecosystem services when a drove road is present, mainly provisioning services having to do with pastures, feed for animals, and livestock, the regulating of fire prevention and connectivity, as well as the cultural services of aesthetic value, cultural identity and tourism. This perception and preference towards positive appreciation of the drove road is probably connected with their lifestyle, cultural identity and local social-ecological knowledge, as livestock raising has historically been one of the main occupations in the study area, and is similar to that of other mountain livestock raisers of Mediterranean Spain (Ruiz 1982).

Environmentalism and biophilia

Another group of participants in our study that also seems to be attracted by the presence of a drove road in a cultural landscape is composed of the most environmental aware, formally educated and informed people, usually with previous knowledge or experience of transhumance. Such people exhibit similar perceptions as the previous group regarding the cropland landscape, but seem to reveal a different awareness about the forest. They appear not to prefer the drove road image as much as in the case of the cropland and recognize less cultural identity and aesthetic values in it. Such group also seems to perceive high levels of biodiversity, hunting, gathering and erosion control in the pine forest either with or without a drove road, and link connectivity to landscapes without a drove road as if they would understand this service more related to forest wildlife than to livestock. Widely described biophilic patterns (Ulrich 1993) might explain this result and significant and positive correlations have previously been found between ecocentrism and the preference for wildlands and cultural landscapes (Kaltenborn and Bjerke 2001). Differences in the degree to which individuals participating in the study preferred wilderness, as opposed to more humanized landscapes, could also indicate, as in preceding studies (González-Bernaldez and Parra 1979; López-Santiago 1994), that university students prefer unpredictable, uncontrolled, challenging landscapes while other stakeholders like farmers and housewives prefer more predictable, controlled, and human-influenced landscapes.

Urban identity and environmental unawareness

One group of respondents – composed mostly of people from a clearly urban context such as Madrid and the small (semirural) cities of La Mancha who don't feel particularly rural, but have higher educational levels and are mostly women – exhibit preferences towards the landscape without a drove road. They perceive supply of ecosystem services such as tranquility/relaxation, wood, air purification and plant regeneration in all tested images and perceive more than the remaining respondents the ecosystem services supplied in the landscape view without a drove road. Previous studies have reported that living environment (urban versus rural) and educational level may influence landscape preferences (e.g., Yu 1995).

Farming cultural identity

The majority of aged farmers (mostly male) living in the small cities of La Mancha report a rural sense of place, value cultural identity and identify high levels of hunting in both images of their local agrarian landscape. They do not prefer the drove road image and tend to perceive higher connectivity and aesthetic values when it is absent. Further, such cropland farmers perceive gathering, fire prevention and soil erosion control, which altogether might provide an image of their specialized local ecological knowledge and sense of place. Nevertheless, they perceive not only high aesthetic value, but also food from agriculture or fire prevention in the forest without a drove road (they do not perceive the risk of fire in this case), perhaps experiencing some difficulties to identify the ecosystem services in this landscape. Farmers have frequently been recognized as a very distinctive group, with a relatively high appreciation of farmland scenes and humanized landscapes (e.g. Daniel & Boster 1976, van der Berg et al. 1998). This group can be seen as being analogous to the farmers described by González-Bernáldez and Parra (1979), who preferred predictable, controlled, human-influenced landscapes, and for which a drove road would probably be perceived as a disturbance in their familiar cropland or typical forest landscape.

Hence, we hold that a preference towards presence of a transhumant drove road in a landscape is the key explanatory variable of ecosystem services social perception in these regions, as revealed by the analysis of both landscape tests. In addition, a rural–urban gradient appears to determine social capacity to identify ecosystem services in different landscapes, explaining this in terms of coupling and decoupling processes, experiential or formal knowledge, and sense of place (Nassauer 2011). Similar synergistic effects of different variables have been observed in previous studies (Gobster 2007).

4.4.5. Concluding remarks: linking ecosystem services research with landscape planning by using a visual perception test

Ecosystem services research has primarily been focused on monetary and biophysical valuations, with few studies choosing to explore socio-cultural preferences (Vihervaara et al. 2010). In general, economic and ecological valuations set aside important considerations within ecosystem services research and practices (Chan et al. 2012). Daniel (2001) has posed questions concerning "what are the desired ecosystem conditions toward which environmental management should strive? (...) How are these factors to be defined and measured, and what levels and/or combinations of these complex bio-ecological variables constitute the most desirable conditions". Also, he asks how are we to determine "the role (if any) that landscape aesthetic quality might play in ecosystem management"? We argue that visual approaches to socio-cultural valuation of ecosystem services, such as the one presented here, may be particularly relevant for informing decision-making about cultural landscapes.

Under current patterns of global change (Ericksen 2008), ecosystem service trade-offs emerging from different landscape management options (Foley et al. 2005, Gordon et al. 2010) should be revealed to inform policy decision making. Urbanized society has increasingly led to land use changes that have triggered the major development of settlements and have, therefore, changed the role of agriculture and created new aspirations for recreation and leisure uses. This process is, obviously, influencing the provision of ecosystem services in many ways (Daily 1997, MA 2003, Metzeger et al. 2006). In this sense, taking public opinion into account and involving all stakeholders into decision-making processes is essential to ensure public support for policies geared towards maintain cultural landscapes. However, it is not easy to capture the aspirations, motivations and visions of various stakeholders when deciding on which management options are the most appropriate with regard to cultural landscapes.

Using visual stimuli as a common communication channel offers interesting possibilities for uncovering people's motivations, perceptions and aspirations regarding the ecosystem services provided by cultural landscapes. This study has shown that photographs can easily be used to address stakeholder perceptions of the kinds of ecosystem services associated with a particular landscape. Evaluations based on visual stimuli are directly linked with human, evolutionary perception skills and with innate human behavior towards the search for well-being. Human perception and experience of our landscape surroundings is agreed to be a key factor for understanding social interactions with the environment (Kaplan 1987, Appleton 1996, Daniel 2001, Gobster 2007). Models developed by Environmental Psychology have shown the human perceptual system to be a tool designed through evolution to seek out opportunities for survival and adaptation to ecosystems. Many studies have shown how, through history, our innate biophilic tendencies have been strongly modulated by cultural influences to fit into particular ecological contexts while, at the same time, arousing strong feelings of identity (see for further discussion Falk and Balling 2010). When asking people about the ecosystem service supply possibilities that they see in different landscapes, their answers tend to be strongly influenced and quite conditioned by their own demands and worldviews. They tend to prefer that which better fulfils their priorities, which seems to be more closely coupled with their real needs the closer to the landscape at hand they live and work. Therefore, we believe that the methodological approach of using visual stimuli can be a successful technique for exploring social perception of ecosystem services in cultural landscapes.

Moreover, this methodological approach can help to improve cultural landscape planning by: (a) making visible the wide range of ecosystem services delivered by cultural landscapes; (b) providing information about people's perceptions and motivations for maintaining such ecosystem services, incorporating both scientific (experimental learning) and local (experiential learning) knowledge; and (c) drawing attention to the consequences of land use changes in terms of ecosystem service trade-offs.

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Appendix A. Description of the variables used in the study

Quantitative variables				
Variable	**Type**	**Attributes**	**Mean**	**Std. deviation**
Education Level	ordinal	1 primary; 2 secondary; 3 university	2.083	0.834
Visit frequency	ordinal	0 never; 1 yearly; 2 monthly; 3weekly	1.374	0.795
Environmental reader	ordinal	0 never; 1 yearly; 2 monthly; 3weekly	0.754	0.956
Age	continuous	ln(age)§	3.551	0.395

Qualitative variables					
Variable	**Type**	**Categories**	**Attributes**	**Frequency**	**Percentage (%)**
La Mancha residents	binary	0	Not resident in La Mancha cropland cultural Landscape	277	88
		1	Resident in La Mancha cropland cultural Landscape	37	12
Serranía residents	binary	0	Not resident in Cuenca pine forest cultural Landscape	185	59
		1	Resident in Cuenca pine forest cultural Landscape	129	41
Rurality degree of residence	categorical	Rural	Less than 2.000 inhabitants	103	33
		Semirural	Between 2.000 and 30.000inhabitants	56	18
		Urban	More than 30.000 inhabitants	155	49
Rural sense	binary	0	The informant doesn't feel themself as rural in lifestyle and worldview	97	31
		1	The informant feels themself as rural in lifestyle and worldview	217	69
Experience with transhumance	binary	0	The informant doesn't report previous experience with transhumance or herders	202	64
		1	The informant reports previous experience with transhumance or herders	112	36
Gender	categorical	Male		176	56
		Female		138	44
Environmental formal education	binary	0	Informant not formally educated and/or trained in environmental sciences or arts & crafts	235	75
		1	Informant formally educated and/or trained in environmental sciences or arts & crafts	79	25
Herders	binary	0	The informant doesn't work as a pastoralist	260	83
		1	The informant works as a pastoralist	54	17
Farmers	binary	0	The informant doesn't work as peasant or farmer	250	80
		1	The informant works as peasant or farmer	64	20
Drove Road Preference	binary	0	The informant choose the image without drove road	152	48
		1	The informant choose the image with drove road	162	52

Appendix B. Ecosystem services explored: descriptions, examples and correspondence classification according to Millennium Assessment (based in de Groot et al., 2002; Oteros-Rozas et al., 2012).

Type of ES	Ecosystem services	Description	Examples	MA
Provisioning	*Gathering*	Mushrooms and wild edible plants and	Asparagus, *Boletus eduli*	Food
	Feed for animals	Cereal crops for animal feeding	Barley, stubble	Food
	Food from agriculture	Crops for human consumption	Olives, wine	Food
	Wood and timber	Forest products used as fuel or as building materials	Pine timber	Fuel / Fibre
	Livestock	Food from livestock	Lamb, veal	Food
Regulating	*Plant regeneration*	Influence of temporal and low stocking grazing (transhumance) in plant regeneration, by facilitating seeds germination	Pines' regeneration	-
	Air purification	Role of ecosystems in bio-geochemical cycles	Clean air	Air quality regulation
	Habitat for species	Provision of suitable living and nursery places for wild species	Rabbits, birds	Provision of habitat
	Fire prevention	Influence of ecosystems' functioning on reducing frequency and extension of fire events	Consumption of inflammable biomass by herbivores	Natural hazard regulation
	Soil erosion control	Role of the root systems and soil biota in soil retention	Retention of soil by roots	Erosion regulation
	Connectivity	Role of ecosystems' structure for allowing animal and plant movement and colonisation	Dispersal of pasture species	Seed dispersal
Cultural	*Tranquillity/ relaxation*	Influence of ecosystems in human physical and psychological well-being by relaxation	Pleasure of walking in the woods	Aesthetic values / Inspiration
	Tourism	Influence of ecosystem in human well-being through recreational activities	Horse-riding, cycling, hiking	Recreation and ecotourism
	Cultural identity	Variety of natural features that embody or reinforce cultural values	Music, pictures, symbols	Cultural diversity
	Hunting	Leisure activity of hunting	Rabbit, partridge	Recreation and ecotourism
	Aesthetic value	Attractive landscape features	Pleasure of a beautiful view	Aesthetic values

Capítulo 4.5

Aprendiendo del pasado en busca de un futuro: servicios de los ecosistemas y resiliencia socio-ecológica en los paisajes culturales de la trashumancia.

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4.5. Ecosystem services and social–ecological resilience in transhumance cultural landscapes: learning from the past, looking for a future

4.5.1. Introduction

Transhumance is a seasonal migration of livestock between summer pastures (highlands, usually northerly latitudes) and winter pastures (lowlands, southerly latitudes). Matching a herd's need for forage with seasonal peaks in pasture availability assures the best year-round supply of feed for the animals (Manzano-Baena & Casas, 2010; Ruiz & Ruiz, 1986). Transhumance is one of the many customary practices developed by ancient Mediterranean societies to cope with an unpredictable and highly fluctuating climate. It creates a cultural landscape that includes a complex mosaic of habitats, each varying in extent and productivity during the year. In addition, transhumance creates social interactions and connections that would not occur without it. The social and ecological characteristics of transhumance landscapes, in turn, shape the eco- system services they provide.

In Spain, transhumance reached its peak during the Middle Ages with the official formation of the Council of the Mesta, an association of transhumant livestock herders whose main objective was to defend their rights in the conflicts with sedentary farmers and local livestock raisers as they migrated among seasonal pastures. During its peak, the number of sheep involved in these movements came to be almost four million, with herds covering distances of up to 700km along a network of drove roads protected from damage and intrusion, twice a year. With the breakdown of the Merino breed monopoly and its valuable wool during the nineteenth century, a continuous decline of transhumance in Spain began. During the twentieth century, the use of rail transport has gradually taken the place of herding along drove roads.

Nevertheless, transhumance in Spain has made it into the twenty-first century, although on a much smaller scale and with a different structure. Winter and summer pasturelands are still connected by a well-established system of drove roads that was granted legal protection in 1995, in recognition of the services the system provides for the maintenance of extensive grazing and local breeds as well as ecological corridors, while acting to link society and nature (Gómez Sal & Lorente, 2004). This network extends over c. 125 000km and occupies c. 422 000 ha (0.83% of the country), and is formed by royal drove roads (cañadas reales), whose legal width is c. 75 m, and smaller trails known as cordeles (c. 37 m) and veredas (c. 20 m wide).

In this chapter, we use the ecosystem services framework to analyse how transhumant practices contribute to resilience building. In doing so, we: (1) characterise the whole range of ecosystem services provided by transhumance cultural landscapes at different scales; (2) discuss the links between the ecosystem services identified and social–ecological resilience, and (3) address how resilience building works in practice in transhumance landscapes. Finally, we provide some insights for the overall management of cultural landscapes.

4.5.2. Conceptual framework: resilience in transhumance cultural landscapes

Transhumance landscapes can be considered cultural landscapes that have been shaped over many centuries of pastoral activities through the adaptation of herder management practices to a harsh and highly fluctuating environment (Herzog et al., 2005). To analyse resilience in transhumance cultural landscapes, we first developed a conceptual framework based on complex systems and resilience theory (Berkes et al., 2003; Folke, 2006). In this context, transhumance landscapes can be understood as social–ecological networks (Janssen et al., 2006), that is, networks of biophysical and social flows generated and maintained by the movement of shepherds and livestock. Under this framework, social–ecological resilience is understood as the capacity of the transhumance landscape to absorb recurrent disturbances so as to retain essential structures, processes and feedbacks (Walker et al., 2004). We assume that part of this capacity lies in the capability of transhumance landscapes to continue to deliver ecosystem services that are essential for human livelihoods and societal development (Adger et al., 2005).

Following Carpenter et al. (2001), to assess a system's resilience, one must specify which system configuration and which disturbances are of interest; in other words, the resilience 'of what' and 'to what'. In our case study, we will analyse the resilience of the transhumance landscape (conceived as a complex social–ecological network) to external drivers of change like economic market forces, agricultural policy changes, sociocultural and institutional changes associated with globalisation, as well as direct drivers such as climate change and other environmental external disturbances.

We assume that the current transhumance landscape configuration, based on the maintenance of livestock movements on foot, configures a desirable state. We therefore consider social–ecological resilience as a positive emergent property of the system, with resilience building as an objective to be promoted in the face of global environmental change.

4.5.3. The Conquense Royal Drove Road as a case study

The transhumance landscape of the Conquense Royal Drove Road (CRDR) comprises a summering area located in the eastern part of Montes Universales (Teruel, Guadalajara and Cuenca provinces), a wintering area located in southeastern Sierra Morena and the southern fields of La Mancha, and the drove road itself, which crosses the central Iberian plateau (mostly in the provinces of Cuenca and Ciudad Real) (Fig.4.5.1).

The summering area is characterised by semi-deciduous and coniferous forests (largely transformed by humans in pine plantations), mixed with patches of fodder crops. Winter pasturelands are more dispersed and are located in lowlands characterised by a typical Mediterranean dehesa landscape (Plieninger & Bieling, This volume). Finally, the drove road consists of a 75-m wide and approximately 410-km long corridor crossing predominantly cultivated areas (mostly vineyards, sunflowers, cereals and olives).

From July to November, sheep flocks and cattle herds avoid the hot and dry Mediterranean summer by staying in the high mountainous areas, where they find refuge, food and water. In early November, when the snow begins to cover mountain pasturelands, most herds start a 25- to 30-day journey, crossing the central plateau on foot, moving towards the warmer pasturelands of the wintering areas located at southern latitudes and lower altitudes, where livestock remains for about six months before returning to the north in early June (Fig.4.5.1).

Even though not all ecosystem services identified are directly linked to transhumance, the maintenance of transhumance landscapes is. Pasturelands and agrosilvopastoral systems in the summering area are strongly dependent on the presence of livestock and climatic limitations make any other type of cattle or sheep management very difficult. In fact, the generalised decline of transhumance in some municipalities has come together with the disappearance of any livestock farming practices. In the wintering area (as in most of the Iberian Peninsula), dehesas are suffering deterioration in two ways.

The forest cycle has been disrupted and oak stands are ageing due to failure of tree regeneration (Plieninger, 2007). This process has been connected to the over-exploitation of estates, which is partially caused by the sedentarisation of previously transhumant herds. As for the CRDR, it is reasonably well maintained because there are livestock drives twice a year, but most of the drove roads in Spain have deteriorated severely due to abandonment.

Figure 4.5.1. The transhumance network of the Conquense Royal Drove Road, including summering and wintering areas. Design: L. Jansen.

According to official livestock movement permits granted in 2009, a total of 87 shepherds with 57,769 heads of sheep were transhumant in our study area. This represents a reduction of 60% in the number of shepherds and 55% in the number of animals compared to the figures recorded in the same area 18 years ago (Bacaicoa et al., 1993). Moreover, most current transhumant shepherds use trucks to move their livestock, with only 15 shepherds with 8,886 sheep and six shepherds with 1,184 heads of cattle (for meat and for bullfighting) walking the CRDR on foot in 2009.

To identify the range of ecosystem services associated with the different areas of the transhumance landscape, comprising the wintering and summering pasturelands as well as the drove road, a thorough literature review and 58 semi-structured interviews with key informants were carried out (February to September 2009). Interview partners were selected through a snowball method and included: shepherds, 33%; decision makers, 23%; farmers, 21%; hunters, 19%; employees from the tertiary sector, 8%; researchers from academia, 6% (Fig.4.5.2). The acknowledgement of ecosystem services directly or indirectly dependent on transhumance was achieved by comparing scenarios with and without transhumance, where all other variables were as similar as possible (biogeographic locations, ecological conditions, sociocultural realities and economic conditions; Oteros-Rozas et al., unpublished data).

The discussion regarding the links between ecosystem services and social-ecological resilience in transhumance landscapes is based on three pillars. Firstly, a literature review has been carried out. Secondly, an expert panel (five researchers from academia and two members of environmental NGOs) and, thirdly, the authors' review of historical trends of transhumance in the study area were used to better understand these links for the case of transhumance, to identify critical tipping points and to analyse how the system has responded to disturbances and coped with external drivers of change. Finally, throughout the investigation, participant observation of researchers accompanying herders during transhumant journeys along the drove road for three years and living together in the summering area for months has been a key source for a deeper understanding of the links between transhumance, ecosystem services and resilience.

Ecosystem services	MA	Summering	Drove road	Wintering
PROVISIONING				
Apiculture	Food	16.67	6.90	0.00
Feed for livestock	Food	66.67	6.90	14.29
Food from agriculture	Food	8.33	20.69	0.00
Food from livestock	Food	58.33	24.14	14.29
Gathering	Food	16.67	34.48	14.29
Manure	-	8.33	3.45	0.00
Textiles	Ornamental resources	16.67	6.90	0.00
Wood	Fibre	25.00	3.45	0.00
REGULATING				
Fire prevention	Human disasters regulation	83.33	13.79	57.14
Seed dispersal	-	16.67	10.34	42.86
Soil fertility	Soil formation	8.33	17.24	42.86
Species control	Pest regulation	8.33	3.45	0.00
Tree regeneration	-	25.00	3.45	57.14
CULTURAL				
Aesthetic landscape	Aesthetic value	8.33	17.24	0.00
Tranquillity	Aesthetic value	0.00	10.34	14.29
Way of exchange	Cultural diversity	8.33	31.03	57.14
Cultural identity	Cultural diversity	50.00	24.14	28.57
Spiritual value	Spiritual value	50.00	24.14	28.57
Traditional ecological knowledge	Knowledge systems	41.67	20.69	57.14
Scientific knowledge	Knowledge systems	8.33	0.00	0.00
Environmental education	Educational values	8.33	10.34	0.00
Nature tourism	Recreation and ecotourism	33.33	58.62	57.14
Rural tourism	Recreation and ecotourism	50.00	6.90	0.00
Recreational hunting	Recreation and ecotourism	25.00	24.14	28.57
Bullfighting	Recreation and ecotourism	8.33	3.45	14.29

Figure 4.5.2. Percentages of interviewees that acknowledged each ecosystem service in the three areas (related to the total of interviewees; *N*=58). MA, Millennium Ecosystem Assessment classification (2005).

4.5.4. Social-ecological resilience and ecosystem services in transhumance landscapes

Changes in ecosystem structure and processes alter the resilience of social-ecological systems and this has profound consequences for services that humans derive from ecosystems (Chapin et al., 2000). Resilient social-ecological systems are able to absorb large impacts without change in fundamental ways and, therefore, they can cope, adapt or reorganise without loss of their capacity to generate ecosystem services (Folke et al., 2002). Hence, it is expected that there is a strong link between social-ecological resilience and the ecosystem services associated with transhumant practices.

A total of 25 ecosystem services were acknowledged by experts and interviewees in the three areas that conform to the network (summering, wintering and across the CRDR; Fig.4.5.1). Of these, eight were classified (MA, 2005) as provisioning services, five as regulating services and twelve as cultural services (Fig.4.5.2). In addition, biodiversity conservation was acknowledged and evaluated as a support for maintaining ecosystem services flows.

A discussion follows here on the links between ecosystem services provided by transhumance landscapes and social–ecological resilience.

4.5.4.1.Provisioning services

Provisioning services are critical for resilience as they contribute to food sovereignty and allow a diversification of sources of income for local people (Adger, 2000). Interviewees from the summering area, more frequently than elsewhere (summering area: 27%; drove road: 13%; wintering area: 5%), acknowledged provisioning services, as this is the original core zone for the transhumance along the CRDR. The local population has been historically linked to extensive livestock practices and this is still an important economic activity in the area.

Food production is now the main objective of transhumant practices. Although satisfaction of basic dietary needs of pastoralists does not rely on their own production of food, the economic sustenance of pastoral families is completely dependent on it. Some transhumant families also have home gardens and/or hens, therefore diversifying their sources of food and income and reducing their vulnerability to market changes and the impact of future climatic changes. Both gardens and chickens benefit from the side products of pastoral production. In addition, gathering of wild plants was identified by 22% of respondents as an important ecosystem service. In the three areas, people collect mushrooms, asparagus and other wild plants from their grazing areas and particularly along the drove road. Some of these products (especially mushrooms) can fetch quite high prices in the local markets (e.g. up to 35 Euro/kg for *Boletus edulis*).

The risk of decreasing functionalities and provision of services in specific food systems becomes high when a society has been heavily affected by a weakened or attenuated public sector and a loss of market structures (Pingali et al., 2005). We believe that transhumance is a good example of this. Conversations of herders witnessed during participant observation as well as the interviews allowed us to identify some of the main drivers of change: global economic competition and the loss of local markets for products, together with sanitary and legislative restrictions (mainly from the EU), have forced shepherds to enlarge their herds in order to achieve economic profitability and, therefore, to face new challenges (e.g. more difficulties for moving, necessity of larger grazing areas and more labour).

4.5.4.2. Regulating services

Regulating services have been related largely to ecological resilience, especially in terms of human disasters regulation, nutrient cycling, and soil formation and ecological connectivity (MA, 2005). The most frequently recognised regulating service in this case study was fire prevention (51% on average), a service highly related to livestock consumption of inflammable biomass. Soil fertility provided by livestock manure in the drove road (17%) and wintering areas (42%) and tree regeneration (29% on average; mainly holm oaks in dehesas and pines in the summering area) were also mentioned (Fig.4.5.2).

The importance of fire prevention associated to consumption of inflammable vegetal material by grazers has largely been documented (e.g. Folke, 2006; Ruíz-Mirazo et al., 2011). The recent decrease in grazing pressure due to the abandonment of livestock farming is one of the major land use changes that has led to the recovery of vegetation (Le Houérou, 1993) and the increase in accumulated fuel (Rego, 1992). As a consequence of the abandonment of land and traditional practices, fire events have increased and landscapes are becoming more homogeneous (Moreno & Oechel, 1994) and, therefore, more vulnerable to environmental changes.

Extensive and mobile livestock contributes to soil fertility, increasing productivity (Gómez Sal, 2003). For instance, as herders explained in the interviews, the customary practice of *redileo* (extensively applied in dehesas and still in use) is crucial to control soil fertility. It consists of enclosing sheep in a limited area at night in order to fertilise the soil with their dung and moving this enclosure every three or four days.

Additionally, as was mentioned before, transhumance is contributing to maintaining dehesas in wintering areas, not only by guaranteeing the presence of extensive livestock systems (against current trends of abandonment or overexploitation) but also by avoiding the impact of year-round grazing pressure on holm oak renewal, which is the worst current threat to the continuity of these ecosystems (Pulido & Díaz, 2005).

Finally, Bunce et al. (2006) found that drove roads acted in the past as ecological corridors for connectivity, but further research is required to determine their current and future role because of the widespread disruption that has taken place in the network. Livestock drove roads are a special case of ecological corridors, the structure of which usually includes other types of linear elements, such as tracks, hedgerows, fences, rivers, etc. (Bunce et al., 2006). The conservation of their structure and their use by the livestock, in connection with the extensive system of pasturelands, may determine their role for conserving species and ecosystem functioning (Pineda et al., 1991). We suggest that, through the dispersal of seeds (Manzano & Malo, 2006) and spores by livestock as well as the association of thismobile livestock with insects and birds, the network of drove roads has an interesting option value: contributing to the connectivity of protected areas in the face of current patterns of climate change.

4.5.4.3.Cultural services

Cultural services are important for social–ecological resilience because of their direct contribution to social and cultural capital building and maintenance (e.g. Folke et al., 2005). A wide diversity of cultural services was acknowledged in this study case (12 services perceived by 22% of interviewees, on average). During the fieldwork, it became clear that cultural identity is the essence of transhumance survival today. This identity was widely recognized and recalled during the interviews (acknowledged by 34% of the interviewees, on average), especially in the summering area (50%) and during participant observation. Both from the society's and the pastoralists' points of view, identity factors are grounded on people's sensitivity and we believe they constitute powerful tools for the reinforcement of the 'sense of place' in transhumance landscapes.

Traditional ecological knowledge (as defined in Berkes et al., 2000) is embedded in the local culture and environment; it is dynamic, constantly adjusted and adapted to new circumstances, evolving through a combination of long-term ecological understanding and learning from crises and mistakes (Berkes & Turner 2006; Olsson & Folke 2001). It increases the capacity of social–ecological systems to deal with crises and maintain resource flows in changing and uncertain conditions (Berkes et al., 2000; Folke et al., 2003; Olsson et al., 2004). This ecosystem service was acknowledged by 40% of the interviewees, on average. Participant observation during the transhumant travel and in the summering and wintering areas revealed that, currently, the transhumant model relies heavily on the transmission of traditional knowledge for coping with uncertainty, as limitations in pasture and water availability are frequent. Especially while travelling, herders deal with many small perturbations (crossing highways and cities, unexpected fires, conflicts with local farmers, etc.). Other aspects of traditional ecological knowledge are those associated with the nomadic lifestyle during spring and autumn trips (i.e. camp setting, ways of cooking, legends and stories told during the journey, plant gathering and rabbit hunting), which constitutes an opportunity for its transmission to younger generations and as a social networking mechanism.

Recreation services associated with transhumant practices are currently gaining importance because the drove road serves as an open public space for leisure activities and as an environmental education asset. The folkloric aspects of this traditional practice are very appealing for the society, and some tourism enterprises in Spain have taken advantage of this fact. We believe that recreation activities can be a social asset for environmental awareness, reinforcing social support for transhumance activities, enhancing social–ecological resilience, and as a way of transmitting traditional ecological knowledge. Social acknowledgment of the importance of transhumance shown by other people to pastoralists contributes to reinforce their self-esteem, encouraging youngsters to engage.

Transhumance in the Iberian Peninsula has traditionally connected very different and disparate populations, cultures and ways of life, meaning a cultural way of exchange. Human communities benefit from the exploitation of ecological edges (Turner et al., 2003), and we believe the drove road can be considered as a continuous edge that increases the diversity of ecological and cultural capital upon which people can draw for their livelihoods. Human societies living 'on the edge', both ecologically and geographically, in terms of their access to the resources of two or more ecosystems, are likely to be more flexible and resilient than people experiencing more homogeneous environments (Turner et al., 2003). Local societies of the transhumance landscape are benefiting from their social interaction and synergies wherein people exchange material goods and learn from one another. This so-called 'edge effect' adds value to transhumance because it brings together people, ideas and institutions (McCay, 2000), making people from different ecological and cultural areas share and interact.

4.5.4.4. Biodiversity conservation

In addition to the previously mentioned ecosystem services, biodiversity conservation was widely recognised by interviewees as a benefit provided by the system. Biodiversity conservation positively affects resilience in two ways: (1) by harbouring a wide range of species that are potential colonists to repopu- late disturbed regions, and (2) by triggering ecological processes and therefore ecosystem services and functions through diverse functional groups (Chapin et al., 1997).

In the same way, herbivore movements increase resilience by: (1) affecting communities and ecosystems as a consequence of direct and indirect effects on other above- and belowground consumers, predators and nutrient cycles, and providing plants with opportunities for regrowth, and (2) creating mosaics of patches with varied functions, incrementing habitat heterogeneity and landscape diversity (Coughenour, 2007). Moreover, Adger et al. (2005) argue that biodiversity enhances resilience if species or functional groups respond differently to environmental fluctuations, so that declines in one group (or one species) are compensated by increases in another. In any case, in dynamic landscapes such as cultural landscapes, biological diversity provides insurance, flexibility and risk spreading across scales (Folke, 2006).

Large herbivores may act as keystone species that determine diversity for the rest of the system. Herbivore movements, either through ecological engineering (Jones et al., 1994) or through landscaping (Sinclair, 2003), result in patch dynamics that derive in meta-stability or persistence at large scales. Some of these effects involve generation of spatial heterogeneity, biodiversity maintaining and spatial food webs (Coughenour, 2007).

Finally, the resilience of ecosystems also depends on the ecological memory provided by mobile link species and their support areas, generating buffer capacity and opportunity for reorganisation (Folke, 2006). Through these processes and interactions, herbivore movements effectively integrate landscape subelements into a landscape meta-ecosystem, for instance, forming a social–ecological network (Lundberg & Moberg, 2003).

4.5.5. History of social–ecological resilience in transhumance landscapes

As we will elucidate here, both human or social nodes and non-human or ecological nodes in transhumance landscapes plus their connections have, presumably, passed through different crises, thus reinventing the network. In our opinion, transhumance in the CRDR has been demonstrated to be a highly resilient system, having survived many disturbances of diverse origin and magnitude without losing its main essence and functionality. From this viewpoint, looking into past crises and the response behaviour of the social–ecological network when confronted with disturbances can help to not only understand the evolution and structure of present transhumance landscapes in the Mediterranean basin but also analyse possible future scenarios under conditions of global environmental change.

Folke et al. (2003) proposed four elements for building resilience in social–ecological systems: (1) learning to live with change and uncertainty; (2) nurturing diversity for reorganisation and renewal; (3) combining different types of knowledge for learning, and (4) creating opportunity for self-organisation. As we will discuss as follows, transhumance landscapes have survived for centuries incorporating these four elements and, looking into the future, these will probably be important determinants.

The loss of the Spanish monopoly of wool production in Europe after the Napoleonic Wars (*c.*1800) resulted in a sharp decline in the number of sheep and a crisis of related institutions (Ruiz & Ruiz, 1986). As a consequence, transhumant livestock rearing redirected the economic outcome from textiles to food production. Current trends in global markets (e.g. Chinese emergent textile industry caused a ~30%–45% annual increase in wool prices during the last three years, and up to a 95% increase in 2011) might reallocate economic value in wool. Market fluctuations, social changes, historical conflicts, changing policies and weather uncertainty have sculptured the resilience of transhumance landscapes, demonstrating their capacity for learning to live with change and uncertainty.

In 1943, livestock began to be transported by train (Abella´n, 1979; Bacaicoa et al., 1993), as this allowed herders to avoid the difficulties and uncertainties of the one-month walking trips and had lower costs. For about 60 years, the train was the most common means of transportation until road networks were improved and enlarged during the last decades of the twentieth century, making the use of truck transportation more comfortable both for animals and shepherds (Manzano-Baena & Casas, 2010; Ruiz & Ruiz, 1986). As soon as the state railway company decided to eliminate livestock trains, most shepherds chose truck transport for transhumance (Bacaicoa et al., 1993). However, some shepherds explained how they regained local knowledge about the drove road by learning from elder shepherds who had walked it, and they went back to transhumance on foot. The survival of social–ecological memory after a change caused by the external factor of railway development, along with the good condition of the drove road, may have allowed this reorganisation of the system.

Recent increases in the price of oil (and, therefore, in truck transportation costs) and of fodder have stimulated other shepherds to return to transhumance on foot. As they explain, the fact that the drove road is still in use has encouraged them and made a small revitalisation possible. In this context, we believe that social and ecological memory provides the framework for coping with new challenges and threats, and a diversity of available strategies offers a chance for reorganisation and renewal.

In 2006, a few cases of bluetongue disease were recorded in some countries, and preventive sanitary restrictions were applied all around Europe, limiting livestock movements. This drastically reduced the numbers of transhumant shepherds and livestock (according to official livestock movement permits granted by local agrarian offices). However, in spite of the many social and economic difficulties that livestock rearing is currently facing in Spain (according to shepherds), we have witnessed a recovery in the number of transhumant herds in the last three years. We consider that contemporary interest stemming from various sources, including a renewed political and management concern for the activity, the interest in organic products by consumers and nature tourists, and the relevance for historical, ethnological, anthropological and ecological research, combined with local knowledge and interest in this historic system, are supporting efforts for a proper valuation of transhumance landscapes by combining different kinds of knowledge (i.e. experimental and experiential knowledge).

We believe that the flexibility of transhumant pastoralists and their ability to cooperate in order to use existing social, economic and political structures as well as 'new' ones (such as the commercialisation of their products within sustainable consumer networks, official quality certifications and the creation of associations) will determine the future resilience of the transhumance landscape. Creating opportunities for self organisation, in the form of strengthening social networks, reinforcing transhumance institutions and empowering individuals so as to ensure a constant flow of demand, a proper valuation of products and social and institutional support to transhumant practices, is probably the most important challenge for their future.

Economic, social and ecological disturbances have forced system components to adapt by learning (e.g. improving pastoralists' techniques) or by selection (e.g. some pastoralists go bankrupt). Individuals, their social relations and social networks are the glue that holds together adaptive governance (Folke, 2006). We have witnessed (like Galvin et al., 2007) how pastoralists with the strongest social capital (e.g. large transhumant families in which members help each other) have been and still demonstrate to be the best able to withstand disturbance. In this sense, the recovery of the traditional practice of moving livestock on foot is being possible now only where a strong network ofmutual support between pastoralists ismaintained (McCay, 2000).

4.5.6. Insights for resilience management in cultural landscapes

Some insights and management implications for a wider context can be derived from the presented case study. We consider that major external drivers are threatening social–ecological resilience in the Mediterranean basin, particularly: the specialisation and intensification of agroecosystems, the loss of medium-impact traditional agrarian practices such as transhumance, and the increase of dependence on external economic subsidies (Evaluación de los Ecosistemas del Milenio de España, 2011). Fraser (2007) found that these three factors stand out as common in historic cases where different environmental problems caused famine. Even though the Spanish context is not likely to suffer from such a critical scenario, we suggest that reflection is needed on whether current policies are contributing to the enhancement or to the reduction of social–ecological resilience in transhumance landscapes.

In this sense, we propose some intervention strategies that might increase the resilience of transhumance cultural landscapes and that could also be applied to other extensive agroecosystems:

1. Strengthening the diversity of income sources for extensive, customary and small-scale farmers and the diversity of ecosystem services provided by the cultural landscape they safeguard so that society would better value these activities. The diversification of new touristic offers, for example, can be an option value for the future. In case of deep economic crisis affecting provisioning services, a diversity of income sources could be an insurance against bankruptcy, thus guaranteeing the survival of transhumance.
2. Capturing social–ecological value in the market values of products derived from agrarian extensive systems and public financial support schemes so that economic profitability is ensured. The increasing pressures of globalised trade and international markets and the resulting competition with more intensified systems are among the main drivers behind transhumance decline. The meat produced by transhumant herds has not yet been certified or tagged under any

official entity. Considering that it has been recognised as having particularly beneficial organoleptic qualities (Alegre, personal communication, 2002), it could easily be commercialised through alternative and high-quality market networks.

3. Improving social recognition of ecosystem services associated with cultural landscapes dependent on traditional practices so that it could impact positively on the maintenance of these activities. Education and communication strategies (e.g. environmental education, documentaries and museums) aiming to promote public awareness can contribute to the necessary sociocultural changes for a sustainable future.

4. Reinforcing social capital through rebuilding local institutions; building on small-farmers' ability to adapt and reorganise; assisting them to better understand new opportunities of commercialisation networks; supporting local trade arrangements and interaction between local populations and small-farmers; reconstructing the capacity of communities to find rapid, flexible solutions to problems and to balance power among the various interest groups and stakeholders, and safeguarding traditional ecological knowledge and its transmission to new generations.

5. Protecting the commons, like communal pasturelands and the drove roads network so that these resources stay accessible to farmers and shepherds. Most of transhumant pastoralists and extensive peasants in general are landless and, therefore, rely on the access to communal territories in order to make their movement on foot possible and their activity viable and economically profitable.

6. Developing new institutional frameworks for adaptive governance seems critical for enhancing resilience in cultural landscapes. Conventional 'command-and-control' management practices that have prevailed in the recent past should be set aside in favour of more adaptive ('learning by doing') co-management approaches (Holling & Meffe, 1996). This entails the sharing of management power and responsibility through multiple institutional links involving both horizontal and vertical cross-scale interactions (government agencies, NGOs, local communities, user groups) and the building of mutual trust among the partners through feedback learning. Moreover, taking into account that the

ecological and social processes that determine landscape dynamics occur at different scales, new polycentric governance schemes (Ostrom, 1998), with multi-level, nested institutional arrangements, should be developed to manage the complexity that lies behind cultural landscapes, while promoting innovation, learning and adaptation. In the face of climate change, adaptation and flexibility of institutions to allow mobility will be fundamental.

4.5.7. Conclusions

The disappearance of livestock movements has increased vulnerability of cultural landscapes associated with transhumant practices. Transhumance constitutes an important enhancer of social-ecological resilience in Mediterranean cultural landscapes through the provision of a wide range of ecosystem services. This traditional livestock raising system provides a good example of the importance of wider acknowledgement and visibility of extensive agrarian practices.

Attention should be paid to traditional management practices, such as transhumance, that safeguard the valuable cultural landscape as an integral part of sustainable land use and provide flexibility and mobility in response to climate variability. In this sense, the ecosystem services framework can be very useful for elucidating these benefits.

In the context of uncertainty that accompanies the global environmental change, the resilience framework can facilitate the understanding of the role traditional practices can play in the future. The study of social-ecological resilience in cultural landscapes related to traditional practices provides us with a look into the past, allowing us to learn from past crises and adaptations and to include this knowledge in forthcoming decisions. Both the cultural landscapes and the social-ecological resilience toolboxes can help in dealingwith complexity and uncertainty when looking for a future in a changing world. Surely systems such as transhumance that have developed in response to climatic uncertainty have much to offer (Fig. 4.5.3).

Figure 4.5.3. A herd of 2,600 sheep moving along the Conquense Royal Drove Road on their way back to the summering areas (Serranía de Cuenca). Photo: E. Oteros-Rozas.

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Capítulo 4.6

Explorando el conocimiento ecológico tradicional de los pastores trashumantes en la España mediterránea.

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4.6. Traditional ecological knowledge among transhumant pastoralists in Mediterranean Spain

Abstract Mobility is a millenary human strategy to deal with environmental change. An outstanding example of mobility is transhumance, an ancient pastoralist practice consisting of the seasonal migration of livestock between ecological regions following peaks in pasture productivity. The maintenance of transhumance partly depends on the preservation of related traditional ecological knowledge (TEK). We (a) identified and characterized social groups holding transhumance-related TEK, (b) analyzed trends in transhumance-related TEK across generations and social groups, (c) examined the factors influencing variation in levels of TEK, and (d) analyzed elements of transhumance-related TEK as examples of adaptive strategies to cope with global change. We used transhumance on the Conquense Drove Road, a major active transhumant network in Spain, as a case study. Through an in-depth literature review, participant observation, semi-structured interviews, and a focus group discussion, we developed a survey to examine transhumance-related knowledge, practices, and beliefs. We collected survey data from 150 informants. Although a rich body of TEK persisted among transhumant shepherds, we found a marked loss of TEK among transhumants born after 1975, who scored one-fifth lower on survey items than other generations. The maintenance of transhumance on foot is the most important factor influencing TEK preservation. We conclude that in developed country settings, maintaining conditions for herd mobility can contribute to enhancing the adaptive capacity of agrarian societies to cope with global environmental change.

Key words: adaptive strategy; drove road; environmental change; mobility; pastoralism; resilience

4.6.1. Introduction

Mobility has historically been a common social and ecological response to change and environmental risks (Agrawal 2008). Nomadic, semi-nomadic, and transhumant pastoralism constitute outstanding examples of mobility-based livelihood strategies. However, pastoralism is facing increasing challenges in the context of global change (e.g., Fernández-Giménez and Le Febre 2006, Nori and Davies 2007, Dong et al. 2011).

Livelihoods based on the movement of livestock are adapted to areas where natural resource availability is highly variable through time and space (Dyson-Hudson and Dyson-Hudson 1980). Because periodic movement allows the adaptation of grazing pressure to the carrying capacity of pasturelands, mobile pastoralism has historically been the dominant type of livestock management strategy in semi-arid tropics, deserts, and highlands. Particularly in semi-arid countries, animal migratory systems are critical for making efficient use of the primary productivity of ecosystems across seasons (Alerstam et al. 2003, Manzano-Baena and Casas 2010).

Transhumance is a mobility strategy consisting of regular seasonal migration of livestock between summer and winter pastures, thus adapting to climate variability and matching grazing pressure with seasonal peaks in pasture availability (Ruiz and Ruiz 1986, Manzano-Baena and Casas 2010). Despite the acknowledged adaptive advantages of mobility, the practice of transhumance and other mobility-based pastoralist strategies is declining worldwide (Dong et al. 2011). This decline is due to a variety of factors, including progressive integration into the global market economy, sedentarization policies, and institutional constraints that disfavor nomadic lifestyles (Davies and Hatfield 2007, Galvin 2009). These pressures, combined with drivers of global environmental change, such as climate and land use changes, challenge practitioners to sustain and protect mobile pastoralism worldwide in recognition of its social, cultural, economic, and ecological assets (Nori and Davies 2007).

In Mediterranean Europe, pastoralism has played a key role in shaping landscapes of High Nature Value, especially in mountainous ecosystems and rural areas (Hatfield and Davies 2006). Transhumance has been a major adaptive practice in Mediterranean pastoralist systems. The Mediterranean ecoregion is characterized by seasonality and highly unpredictable rainfall, resulting in high climatic variability (Blondel 2006). Pasture productivity follows seasonal patterns and varies among years (Gómez Sal 2000).

Transhumance persists in some countries like Spain, although with a different structure and at a smaller scale than in the past (Bunce et al. 2006, Manzano and Malo 2006, Fernández-Giménez and Fillat Estaque 2012).

Transhumance requires deep knowledge about the location and availability of natural resources, including spatial and temporal patterns, responses to disturbances such as diseases, ecosystem types, and formal and informal institutions regulating transhumance. In this sense, traditional ecological knowledge (TEK), i.e., the cumulative body of knowledge, practices, and beliefs regarding the relationships of living things to their environment that evolves by adaptive processes and is handed down through generations (Berkes et al. 2000), becomes a crucial asset for mobile pastoralist livelihoods. In this study, we approached transhumance as a livestock management system and defined transhumance-related TEK as the body of knowledge, practices, and beliefs associated with this pastoral practice. Our work assumed that TEK is an essential part of the social-ecological memory of transhumance, as it contains ecological and cultural information enabling practitioners to adapt to change (Berkes et al. 2003, Fernández-Giménez and Fillat Estaque 2012). Furthermore, TEK can provide valuable information that complements scientific studies to improve the understanding and stewardship of ecosystems (Huntington 2000, Knapp and Fernández-Giménez 2009, Fernández-Giménez and Fillat Estaque 2012).

In this paper, we examine trends in and factors influencing TEK among transhumant pastoralists in Mediterranean Spain. Our research pursued four objectives: (1) to identify and characterize social groups holding transhumance-related TEK, (2) to analyze trends in transhumance-related TEK across generations and social groups, (3) to examine the factors influencing variation in levels of TEK, and (4) to analyze elements of transhumance-related TEK as examples of adaptive strategies.

4.6.2. The case study

We conducted this research as part of a larger study intended to evaluate ecosystem services related to transhumance on the Conquense Drove Road (CDR) (González et al. 2012), a major active transhumant network in Spain. The CDR is located in the northwestern Mediterranean Basin on the Iberian Peninsula (Fig.4.6.1).

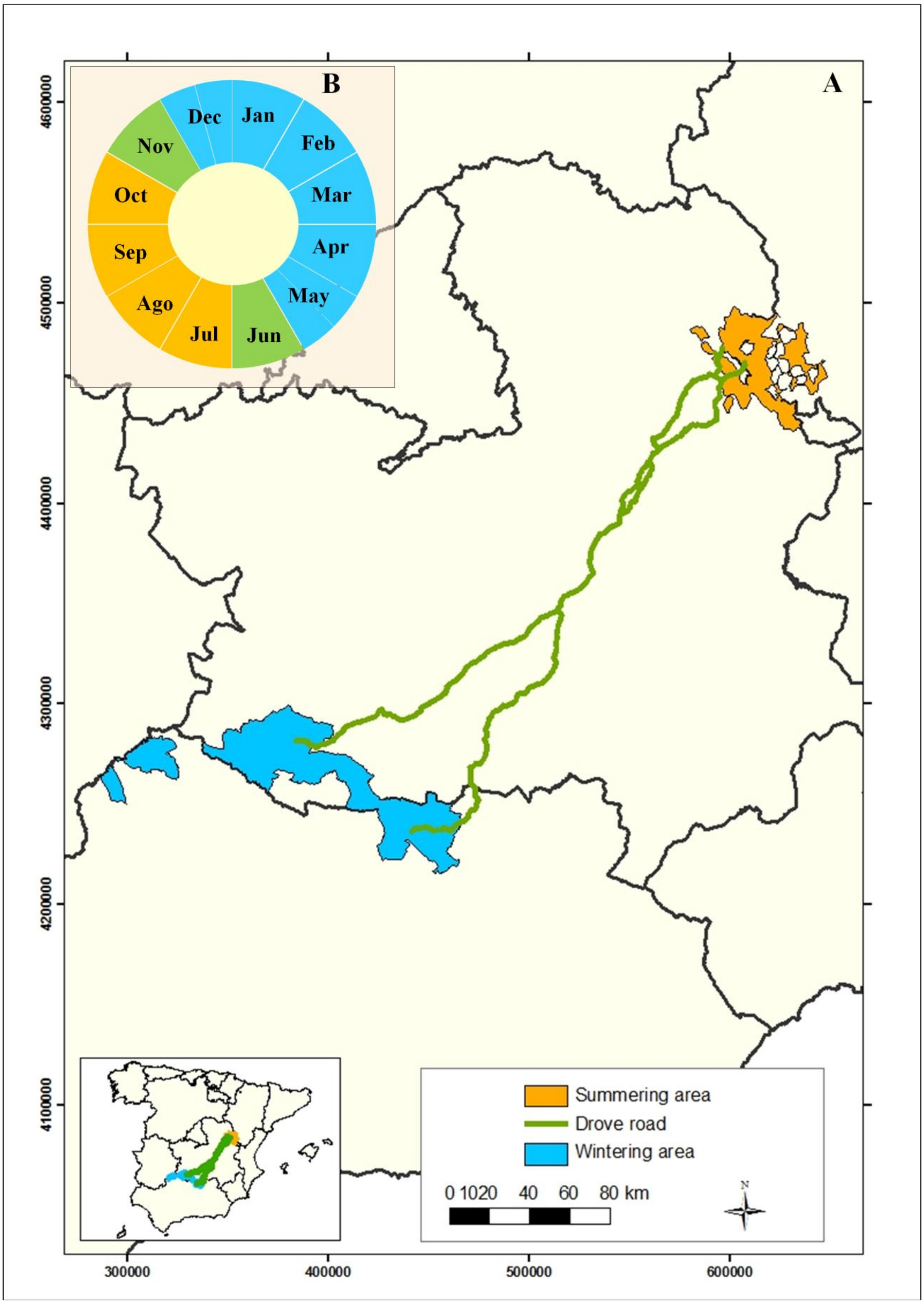

Figure 4.6.1. Map of the Conquense Drove Road social-ecological network showing summering and wintering areas (A); and the annual cycle of transhumant movements on foot (B).

The Iberian Peninsula is dominated by a Mediterranean climate, which provides an ecological rationale for transhumance. The peninsula's geographic configuration is determined by a low-lying area in the south and west, which is the wintering area from which most drove roads depart to northern mountainous areas. Winter pastures are situated in areas where the mean temperature during the coldest month is above 6ºC, whereas summer pastures lie in areas where the mean temperature in the hottest month does not exceed 17°C (Garzón 2001).

In Spain, transhumance peaked at the end of the 18th century, when an estimated nearly 4 million sheep were moved distances of up to 700 km twice yearly along an extensive network of drove roads (Bilbao and Fernández de Pinedo 1982). According to Cazorla et al. (2008), this network extended more than 125,000 km and occupied ca. 422,000 ha, or 0.83% of the country. The network comprises different types of droves: royal drove roads termed *cañadas reales* with legal widths of ca. 75 m, and smaller trails known as *cordeles* and *veredas* with widths of 37 and 20 m, respectively. With the breakdown of the Spanish monopoly on Merino wool in the 19th century, pastoralism and transhumance in Spain progressively declined (García-Martín 2004). After 1943, the use of rail transport gradually led to the abandonment of the routes on foot (Abellán and Olivera 1979, Bacaicoa Salaverri et al. 1993). For about 50 years from the early 1940s to 1993, trains were the most common means of sheep transportation, as they were more comfortable than walking and inexpensive. However, shepherds continued to move their herds on foot for up to 5 days from their rangelands to train stations, partially maintaining the foot-based tradition.

The development of the Spanish highway network in the 1980s and economic growth following Spain's integration in the European Union (EU) made truck transportation of herds an affordable and more comfortable alternative for shepherds. Shepherds faced declining competition and increasing production costs as a result of intensification and sedentarization, with EU subsidies accounting for increasing proportions of their incomes (García-Martínez et al. 2009). During the 1980s, most shepherds in Spain abandoned transhumance on foot in favor of railway and truck transport (Ruiz and Ruiz 1986, Manzano-Baena and Casas 2010). This tendency peaked in the early 1990s, when the state railway company eliminated livestock trains (Bacaicoa Salaverri et al. 1993). At this time, some shepherds resumed transhumance on foot on the CDR for primarily economic and cultural identity reasons: truck transportation costs consumed approximately 10% of revenues and each trip on foot recalled, revived, and reinforced the transhumant identity. In 2006, after the appearance of bluetongue disease, preventive sanitary restrictions applied throughout Europe limited livestock movement, reducing the total number of livestock head and transhumant shepherds in Spain.

Recent increases in the production costs of products such as fodder and oil have encouraged some shepherds to resume transhumance on foot (Fernández-Giménez and Fillat Estaque 2012, Oteros-Rozas et al. 2012b). This shift has been possible in part because of the maintenance of the extensive network of drove roads connecting winter and summer pasturelands. The 1995 Drove Road Act granted legal protection to this public network in recognition of the benefits drove roads provide by facilitating extensive grazing and the maintenance of local breeds and ecological corridors (García-Martín 2004, Gómez Sal and Lorente 2004, Mangas-Navas 2004). Several authors have suggested that transhumance remains relevant in developed country settings and have provided important insights on how to adapt to changing economic and social conditions (Fernández-Giménez and Fillat Estaque 2012). However, the same authors have also noted that an ongoing aging process due to limited intergenerational turnover threatens much of the TEK associated with pastoralist systems. Social and market forces seem to be driving the loss of customary herders' knowledge in other TEK systems in rural Spain (e.g., Ruiz and Ruiz 1986, Gómez-Baggethun et al. 2010, 2012, Reyes-García et al. 2010).

The CDR has been characterized as a social-ecological network (sensu Janssen et al. 2006), i.e., an "adaptive network of biophysical and social flows generated and maintained by the movement of shepherds and livestock" (Oteros-Rozas et al. 2012a, p. 243). It comprises three areas (Fig. 4.6.1): (a) a summering area, (b) a wintering area and (c) the drove road. The summering area, where herds stay from July to October, is located in the eastern Montes Universales in Teruel, Guadalajara, and Cuenca provinces. This area is characterized by semi-deciduous vegetation, coniferous forests, and agricultural patches where fodder crops are grown. The wintering area, where herds stay from December to May, is located in the southeastern Sierra Morena and the southern fields of La-Mancha. This area is characterized by a typical Mediterranean *dehesa* landscape, an agrosilvopastoral ecosystem aimed mainly at extensive livestock grazing. The drove road is a 75-m-wide and approximately 410-km-long corridor that crosses predominantly cultivated areas in the Iberian Central Plateau consisting mostly of vineyards, olive orchards, and fields of sunflowers and cereals. In 2009, local agrarian offices granted livestock movement permits through the CDR to 87 transhumant shepherds, most of whom used trucks but 15 of whom walked the drove with approximately 8,900 sheep and 1,200 cows (Oteros-Rozas et al. 2012b).

4.6.3. Methods

4.6.3.1. Data collection

A team of researchers who had worked with local transhumants for about 3 years conducted fieldwork from June 2010 to August 2011. Participant observation during 19 1–5-week periods was a major source of information. Data collection was organized in three phases: (1) background information collection, (2) focus group, and (3) systematic data collection (Fig. 4.6.2).

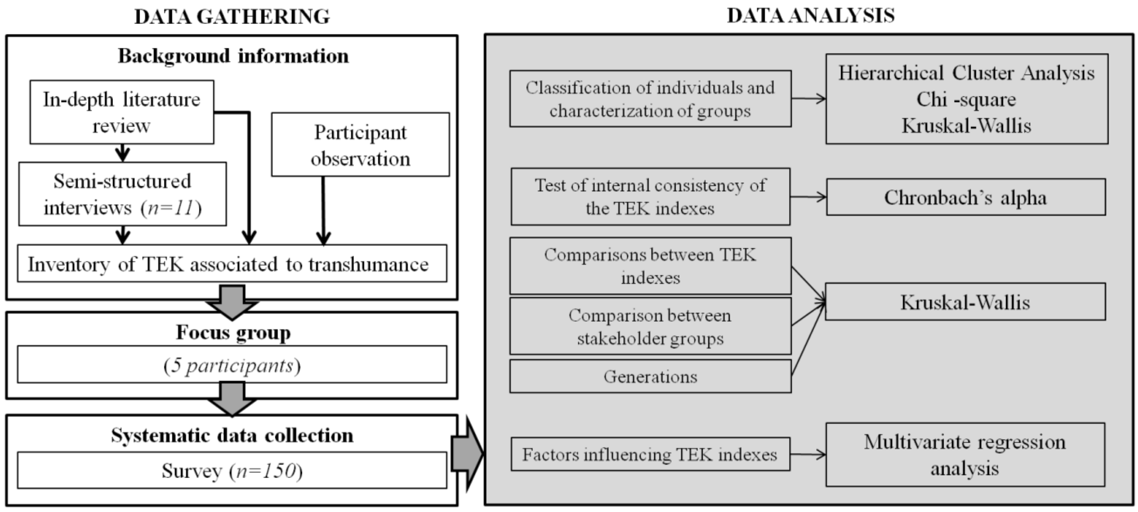

Figure 4.6.2. Methods of data collection and analysis.

Background information

The collection of background information began with an in-depth review of documents and archives in two local museums, the *Museo de la Trashumancia* in Guadalaviar and the *Museo de Ganadería Extensiva* in Checa, and the *Centro de Estudios de la Trashumancia*. Interviews with shepherds were also retrieved from the audio archives of the *Museo de la Trashumancia* and partially transcribed and processed using qualitative data analysis software.

Between June and September 2010, we conducted semi-structured interviews with 11 key informants, two women and nine men aged 45–93 years. All key informants were transhumant or ex-transhumant shepherds, including retired and/or settled individuals. We drew on the knowledge of informants living in summering areas and used a snowball sampling technique (Bernard 2005) to select shepherds with long family and personal traditions as transhumants. We based the number of key informants on the recurrence of similar information in interviews. The sample size for semi-structured interviews represented 5–10% of the survey sample. Interviews were structured around six topics: (1) weather forecasts and indicators of water and pasture availability; (2) knowledge and practices related to livestock management, such as animal behavior, herd composition, wool production, sanitary practices, use of farming tools, and assistance of dogs and horses; (3) management of pasturelands and croplands, including plant species and their distribution and properties for livestock grazing; (4) formal and informal institutions such as land tenure regimes, farmers' associations, social hierarchies, and division of tasks among shepherds; (5) changes in resources, technologies, practices, schedules, knowledge, and household livelihood strategies; and (6) other information related to the cultural transmission of transhumance-related TEK, such as songs, poems, legends, proverbs, and recipes. The interviews were recorded and then transcribed and tagged using qualitative data analysis software. Based on the literature review and analysis of interviews, we built an inventory of transhumance-related TEK. We identified about 90 practices and beliefs and classified them in the six topical categories used to structure the interviews.

Focus group

We organized a focus group to discern well-established transhumance-related TEK from local variants. Five of the 11 key informants from the first phase, two women and three men, participated in this focus group.

From the preliminary inventory of transhumance-related TEK, we selected items for a focus group discussion based on four criteria: (1) relevance to the transhumance system, (2) practices that had changed substantially in the last 50 years, (3) practices related to adaptation to disturbances, and (4) importance for the management of natural resources such as pastures, croplands, and forests. We selected only items mentioned by at least two informants during in-depth interviews.

Systematic data collection

We used the background information and focus group discussion to construct a transhumance-related TEK questionnaire using a methodology similar to that of Gómez-Baggethun et al. (2010). The questionnaire consisted of 36 open-ended questions about transhumance-related practices, knowledge, and beliefs (Appendix A) and also solicited information about interviewees' sociocultural and demographic characteristics (Table 4.6.1).

The survey was administered face-to-face to 150 people. To locate informants, we used the last available census of transhumants in the area, which included individuals working on 95 livestock farms who had conducted transhumance between 2004 and 2009 (Oteros-Rozas et al. 2012b). More than 95% of farms in this census were surveyed. We interviewed the head of each livestock farm and, when possible, one or two of his sons/daughters. The survey was carried out during the summer vacation period to ensure the inclusion of relatives who had migrated to urban areas. We focused mainly on men because the local gender-based division of labor typically assigns livestock-raising practices to men. Three outliers that did not fit within the 95% confidence interval for TEK scores were excluded from the analyses, resulting in a final sample of 147 interviewees.

4.6.3.2.Data analysis

Using responses to survey questions, we constructed an index that served as a proxy for individual transhumance-related TEK (Reyes-García et al. 2007, Gómez-Baggethun et al. 2010). To evaluate informants' responses to survey questions, we constructed an answer key using data obtained in the background information phase, the focus group discussion, and the experience of the team that carried out fieldwork. Each response was coded on a scale ranging from 0, indicating a completely incorrect response or no knowledge, to 1, indicating a completely correct response, depending on the degree to which the informant's answer matched the answer key.

We also examined different components of TEK using five sub-indexes constructed with the partial sums of questions referring to specific bodies of TEK (Table 4.6.1, Appendix A): (1) "TEK_past," which included 14 questions about ancient and past practices or situations that do not currently occur, such as wolf attacks; (2) "TEK_transhumance," which included 14 questions referring exclusively to the transhumance livestock raising system; (3) "TEK_environment," which included 11 questions regarding relationships to ecosystem management; (4) "TEK_indicators," which included three questions about indicators of meteorological change; and (5) "TEK_sanitary," which included four questions about traditional sanitary practices for maintaining or restoring animal health.

Because practice is a major component of TEK systems (Berkes et al. 2000), we explored relationships between the actual use of some current practices and TEK preservation (Reyes-García et al. 2007) by asking "When was the last time you used this practice?" for a subset of seven questions. We then assigned scores of use as follows: 3, indicating that the person used the practice in 2011; 2, indicating use of the practice at least once in the last 5 years; 1, indicating use more than 5 years ago; and 0, indicating that the person had never used the practice. We calculated another index named "Use" as the average of partial scores obtained for these seven questions. To facilitate comparability, we transformed all TEK and Use scores to percentages. Cronbach's alpha tests were used to check the internal consistency of all TEK indexes (Appendix A) (see also Reyes-García et al. 2006, Gómez-Baggethun et al. 2010).

To characterize the sample population, we performed a hierarchical cluster analysis (HCA) that classified interviewees according to TEK scores. We used the Bray Curtis distance and Ward (1963) methods as agglomerative techniques. Then, we used Kruskal–Wallis and chi-squared tests to characterize groups defined by HCA according to sociocultural and demographic variables (García-Llorente et al. 2011).

We used informants' reported ages to create the "generation" variable, which contained four age classes: young, born after 1975; middle-aged, born between 1960 and 1974; mature, born between 1945 and 1959; and elderly, born before 1945. We also created a "last transhumance" variable to explore the interference of potential breaking points in the continuity of transhumance: Spanish rural exodus, for which we considered 1975 to be a critical point; withdrawal of public trains to carry livestock in 1993; and the bluetongue disease outbreak in 2006. The following values were used for this variable: 0, indicating that the informant had never practiced transhumance; 1, indicating last transhumance before 1975; 2, last transhumance between 1975 and 1993; 3, last transhumance between 1994 and 2005; and 4, indicating abandonment of transhumance after 2006.

We used Kruskal–Wallis and post hoc Tukey's tests to compare the distributions of TEK and Use indexes. Differences in indexes among interviewees were also explored with Kruskal–Wallis and chi-squared tests. To explore the factors influencing TEK, we performed ordinary least-squares regressions using TEK_general, TEK_past, TEK_transhumance, and TEK_environment scores as dependent variables and sociocultural and demographic characteristics as explanatory variables. All quantitative variables were ln-transformed prior to analyses. We used adjusted R^2 and the Akaike information criterion to compare the models' predictive power and parsimony, respectively. We forced the inclusion of education level in all models to reveal its positive/negative influence.

4.6.4. Results

4.6.4.1. Characterization of TEK holders

The survey sample comprised 17 women and 133 men aged 20–94 (mean, 53) years. About 80% of interviewees were the children of transhumants and approximately the same proportion were active full-time livestock raisers. Half of the survey sample had conducted transhumance on foot at least once in their lifetimes and 68% had travelled by train with livestock at least once. Only 12% and 33% of informants, respectively, had conducted transhumance on foot and by truck in 2011 (Table 4.6.1).

Table 4.6.1. Description and descriptive statistics of variables used in the analyses.

Variables	Description	Mean	SD
Dependent variables			
TEK_general	Sum of the score obtained in 36 questions related to transhumance. Standardized 0-100 (continuous)	59.76	12.78
TEK_past	Sum of the score obtained in 14 questions referring to how things were done in the past, ancient practices, or situations that do not occur nowadays. Standardized 0-100 (continuous)	51.28	14.00
TEK_transhumance	Sum of the score obtained in 14 questions referring exclusively to the transhumance livestock raising model. Standardized 0-100 (continuous)	57.04	16.40
TEK_environment	Sum of the score obtained in 11 questions referring to the relationships to and management of ecosystems. Standardized 0-100 (continuous)	53.94	15.07
TEK_indicators	Sum of the score obtained in 3 questions referring to indicators of meteorological changes. Standardized 0-100 (continuous)	70.80	20.59
TEK_sanitary	Sum of the score obtained in 4 questions referring to sanitary practices for maintaining or restoring animal health. Standardized 0-100 (continuous)	32.40	12.74
Use	Sum of the score obtained in 7 questions referring to the use of practices (3, indicating that the person used the practice in 2011; 2, indicating use of the practice at least once in the last 5 years; 1, indicating use more than 5 years ago; and 0, indicating that the person had never used the practice). Standardized 0-100 (continuous)	1.10	0.59
Independent variables (continuous)		**Mean**	**SD**
Age	Age of the infomant, in years	53.29	18.16
Years transhumance on foot	Number of years the informant had done the transhumance on foot	3.62	5.71
Years transhumance by truck	Number of years the informant had done the transhumance by truck	10.16	7.16
Years transhumance by train	Number of years the informant had done the transhumance by train	10.47	9.86
Independent variables (dummies and ordinals)			**%**
Male	Gender of the respondent (male=1, female=0)		89.12
Children of transhumant	Is the informant the son/daughter of a transhumant?; 1: yes, 0: no		80.27
Livestock raising as main occupation	Is the informant currently a full-time livestock raiser?; 1: yes, 0: no		78.91
Transhumant on foot at least once	Has the informant ever done transhumance on foot?; 1: yes, 0: no		51.02
Transhumant by train at least once	Has the informant ever done transhumance by truck?; 1: yes, 0: no		68.02
Transhumant on foot	Does the informant currently practice transhumance on foot?; 1: yes, 0: no		11.56
Transhumant by truck	Does the informant currently practice transhumance by truck?; 1: yes, 0: no		33.33
Transhumant	Does the informant currently practice transhumance?; 1: yes, 0: no		42.86

Variables	Description	Mean	SD
Generation	**Ordinal**		
Born after 1975	young		24.49
Born :1960 and 1974	middle		23.81
Born: 1945 and 1959	mature		21.77
Born before 1945	elder		29.93
Education level	**Ordinal**		
No studies	0		8.16
Studied until age of 10	1		14.29
Primary education	2		46.26
Secondary education	3		17.01
High school	4		2.72
Vocational education	5		8.16
University	6		3.40
Last transhumance	**Ordinal**		
Never	0		6.12
Before 1975	1		5.44
1975-1993	2		10.88
1994-2005	3		23.81
After 2006	4		53.74

Based on interviewees' answers to the 36 TEK questions, the HCA divided the sample into four groups (Table 4.6.2).

- Group A included the youngest people in the sample (age < 46 years), who were not currently transhumants or livestock raisers, but who had accompanied other transhumants on foot for about 3 years.
- Group B included middle-aged and young people (23–61 years), of which 64% raised livestock, with no tradition of transhumance in their grandparents' generation. This group also included young people who had accompanied older shepherds, including friends and family members, on a few transhumance trips on foot.
- Group C included mostly middle-aged informants (22–79 years), although they were older than interviewees in group B. This group included individuals who practiced transhumance by truck and 87% of the group comprised ex-transhumants who continued to raise livestock but had discontinued the practice of transhumance, mainly after 2006.

- Group D included elderly individuals (mean age, 63 years), most of whom were experienced retired or current transhumants, and heirs of transhumants. This group included 65% of currently active transhumants on foot.

Table 4.6.2. Characterization of interviewee groups resulting from hierarchical cluster analysis.

Variables	χ2	*p*-value	Group A	Group B	Group C	Group D
Age (years; mean±SD)	44.983	< 0.0001	31±7	42±16	49±16	63±15
Years transhumance on foot (average)	29.667	< 0.0001	3	1	2	6
Years transhumance by truck (average)	1.937	0.58	8	10	10	11
Years transhumance by train (average)	28.361	< 0.0001	3	6	9	15
Male (n)	1.308	0.727	7	24	42	57
Children of transhumant (%)	3.433	0.318	75	64	71	73
Full-time livestock raiser (%)	2.558	0.465	13	64	87	86
Transhumant on foot at least once (%)	3.199	0.362	25	11	44	74
Transhumant by train at least once (%)	1.359	0.715	13	36	69	86
Transhumant on foot (%)	4.377	0.224	0	7	9	17
Transhumant by truck (%)	12.534	0.006	0	50	42	24
Transhumant (%)	8.923	0.030	0	57	47	41
Grandchildren of a transhumant on foot (%)	8.360	0.039	3	15	14	25
Generation (mode)	51.812	< 0.0001	1	1	3	4
Education level (mode)	14.986	0.663	3	2	2	2
Last transhumance (mode)	12.908	0.376	4	4	4	4
N			**8**	**28**	**45**	**66**

4.6.4.2.Trends in cultural transmission and use of TEK

Among the six TEK indexes, TEK_indicators was highest and TEK_sanitary was lowest; both with statistically significant differences from the other indexes (Fig. 4.6.3). Among the remaining four indexes, TEK_past and TEK_environment were significantly lower than the other two indexes. The Use index was lower than most TEK indexes. Only four of six TEK indexes yielded Cronbach's alpha values > 0.6 (Appendix A), indicating high internal consistency. Thus, we considered only these four indexes in further analyses: TEK_general, TEK_past, TEK_transhumance, and TEK_environment.

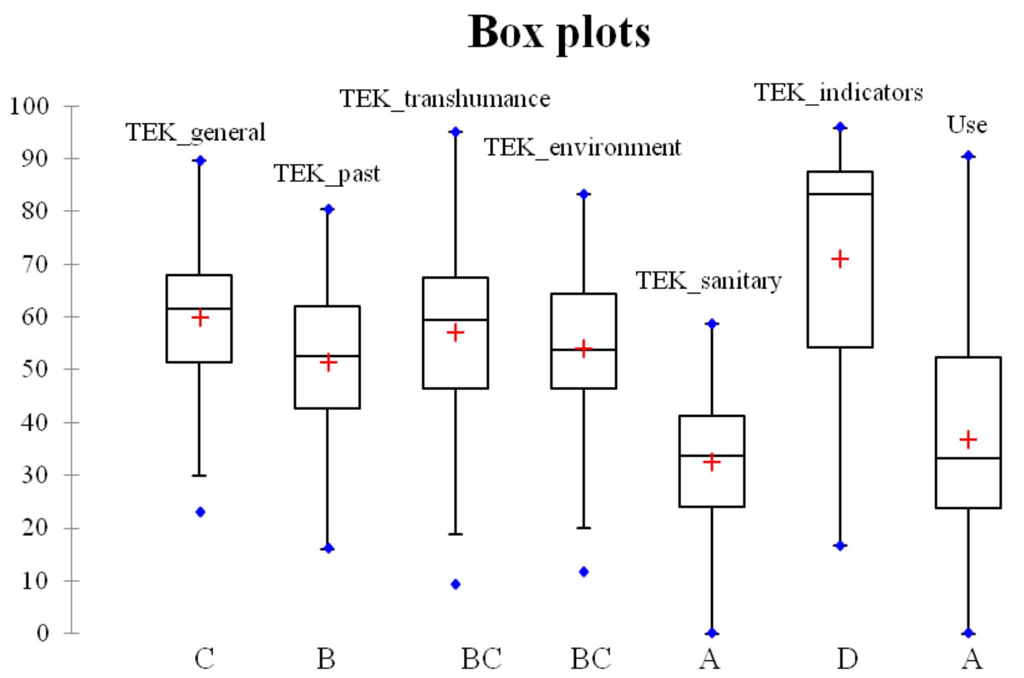

Figure 4.6.3. Comparison of box-plot distributions for traditional ecological knowledge and Use indexes. Different letters denote significant differences among groups (post hoc non-parametric Tukey's test, p-value < 0.05).

Mean TEK scores for these four indexes differed significantly among groups of interviewees (Table 4.6.3). The eldest and most experienced transhumants, categorized in group D, scored significantly higher than did those in the other three groups. Scores were lowest in group A. We also found significant differences in TEK indexes among those that had predominantly abandoned the activity, classified in groups A and B, and the rest of the sample. TEK scores were significantly lower in the young generation than in the rest of the sample; this difference was 20.2% on average for TEK_general and 25.3% for TEK_past.

Table 4.6.3. Comparison of mean traditional ecological knowledge and Use indexes among interviewee groups defined by hierarchical cluster analysis (HCA) and generations.

Variables	Values	TEK_general		TEK_past		TEK_transhumance		TEK_environment		Use	
		Mean TEK	Kruskal-Wallis	Mean TEK	Kruskal-Wallis	Mean TEK	Kruskal-Wallis	Mean TEK	Kruskal-Wallis	Mean Use	Kruskal-Wallis
Groups HCA	A	29.91^{A}		19.84^{A}		24.23^{A}		22.59^{A}		10.12^{A}	
	B	47.58^{A}	$\chi2$ = 103.39***	40.11^{AB}	$\chi2$ = 84.01***	39.98^{A}	$\chi2$ = 88.70***	43.39^{A}	$\chi2$ = 61.02***	36.91^{B}	$\chi2$ = 15.66***
	C	58.06^{B}		48.73^{B}		56.41^{B}		52.79^{B}		37.04^{B}	
	D	69.71^{C}		61.56^{C}		68.69^{C}		63.00^{C}		39.47^{B}	
Generations	young	49.98^{A}		40.52^{A}		45.98^{A}		44.00^{A}		33.47^{A}	
	middle	60.65^{B}	$\chi2$ = 29.49***	50.03^{AB}	$\chi2$ = 36.76***	58.75^{B}	$\chi2$ = 19.84***	55.76^{B}	$\chi2$ = 18.87***	38.23^{AB}	$\chi2$ = 14.13***
	mature	60.97^{B}		52.86^{BC}		59.27^{B}		55.29^{B}		46.73^{B}	
	elder	66.17^{B}		59.92^{C}		63.11^{B}		59.65^{B}		30.63^{A}	
Mean		59.760		51.278		57.044		53.942		36.640	

*Note: *, ** and *** significant at the ≤10%, ≤5% and ≤1% level; superindexes (A, B and C) indicate the result of the Dunn's multiple comparison test showing significance at the ≤10% level.*

The Use index also differed significantly among groups of interviewees and generations. We observed a significant disparity between group A, which contained young individuals who had lost the link with transhumance and scored lowest, and the rest of the sample. We found no difference in the Use index among groups B, C, and D. An intergenerational break in the use of TEK was apparent between the middle-aged and mature generations, with the latter achieving the highest scores. The Use index was lowest among elders since most of these individuals were retired.

Trends in the TEK_general and Use indexes across generations showed dissimilar patterns (Fig. 4.6.4). TEK scores were similar in the middle-aged and mature generations, but the Use index was highest among interviewees aged 51–68 years. We also found that patterns of the TEK_general and Use indexes differed among groups. The Use index was similar between groups B and C, but TEK scores were higher in group C, which comprised truck-based transhumants and settled ex-transhumants, than in group B.

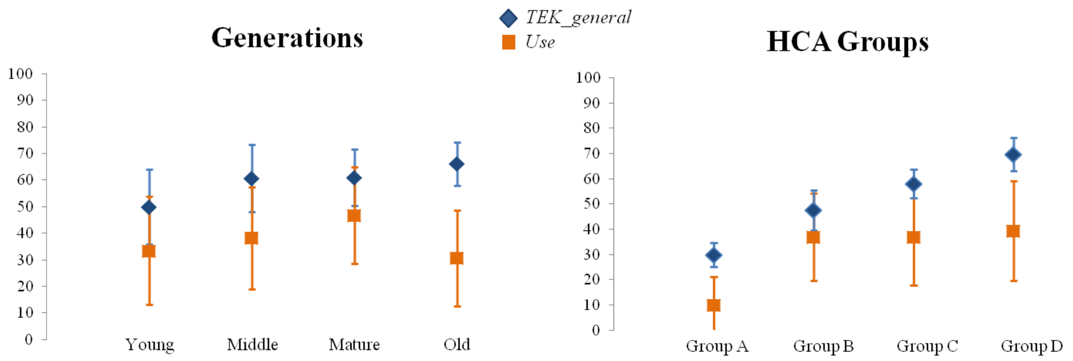

Figure 4.6.4. Comparison of TEK_general and Use indexes (mean ± standard deviation) among generations and groups defined by hierarchical cluster analysis (HCA).

4.6.4.3.Factors explaining levels of TEK

Several sociodemographic variables were associated with our measure of TEK_general (Table 4.6.4). Transhumance practice on foot and male gender were most positively and significantly associated with TEK. TEK_general scores were significantly lower among young informants than among middle-aged and mature informants, whereas scores were highest among elders. Other characteristics, such as raising livestock and train-based transhumance experience, were also positively associated with higher TEK scores, although the coefficients were small.

We found significant associations between most sociodemographic variables and TEK_past, except that current transhumance practice and train-based transhumance experience were not components of the best model. Instead, shepherds who had recently practiced transhumance tended to score slightly higher than those who had abandoned the practice earlier. Male gender and full-time livestock raising were the aspects of general transhumance-related TEK that were most closely related to past practices.

The best model for TEK_transhumance contained most variables included in the TEK_general model, except for livestock raising as a main occupation, which was not significantly related, and train-based transhumance experience, which was included in the best model but was not significant. For this index, current transhumants on foot and men showed the strongest relationships with higher TEK scores.

Finally, variables associated with TEK_environment showed the same patterns and significance as in the regression model for TEK_general, with one exception. Experience with train-based transhumance at least once in the informant's lifetime was not significant in the best model for this index.

In sum, the most important factors associated with TEK scores in the four models were age, gender, to keep practicing transhumance on foot or having done it in recent years, and full-time livestock raising. Education level was negatively associated with all TEK indexes, but this relationship was not significant in any model.

Table 4.6.4. Results of multiple regression analyses performed to identify factors influencing traditional ecological knowledge indexes.

Explanatory Variables	**Dependent Variables**							
	TEK_general		**TEK_past**		**TEK_transhumance**		**TEK_environment**	
	Coefficient	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
Last transhumance	^	^	-0.093	-1.179	^	^	^	^
Years he/she has done transhumance on foot	^	^	^	^	^	^	^	^
Years he/she has done transhumance by truck	^	^	^	^	^	^	^	^
Years he/she has done transhumance by train	0.085	1.097	0.189	2.361 **	0.173	2.013 **	0.077	0.844
Generation								
Young	-0.193	-2.905 ***	-0.184	-2.299 ***	-0.179	-2.381 **	-0.211	-2.691 ***
Middle	^	^	^	^	^	^	^	^
Mature	^	^	^	^	^	^	^	^
Elder	0.185	3.050 ***	0.169	2.124 **	0.134	1.957 *	0.129	1.800 *
Male	0.295	4.776 ***	0.220	3.251 ***	0.269	3.916 ***	0.208	2.850 ***
Formal education above primary studies	-0.084	-1.254	-0.037	-0.455	-0.099	-1.342	-0.078	-0.993
Livestock raising as main occupation	0.202	3.370 ***	0.264	3.455 ***	^	^	0.162	2.285 **
He/she is currently a transhumant on foot	0.381	6.796 ***	^	^	0.390	6.192 ***	0.350	5.286 ***
He/she is currently a transhumant by truck	^	^	^	^	^	^	^	^
He/she has done transhumance on foot at least once	^	^	^	^	^	^	^	^
He/she has done transhumance by train at least once	0.133	1.669 ***	^	^	0.146	1.621	0.126	1.337
R^2	0.615		0.418		0.500		0.462	
R^2 adjusted	0.593		0.389		0.476		0.431	
AIC	-533.75		-393.054		-388.5881		-386.776	

*Note: *, ** and *** significant at the ≤10%, ≤5% and ≤1% level. ^ variable not selected by the best model.*

4.6.4.4.TEK elements as examples of adaptive strategies

From the whole inventory of identified transhumance-related TEK on the CDR, we identified 14 examples of knowledge, practices, or beliefs that are described in Table 4.6.5 and we used to illustrate adaptive strategies according to previously categorized typologies (Agrawal 2008, Gómez-Baggethun et al. 2012). Three strategies were included in the mobility category, four strategies were included in the diversification category, and three practices were selected to illustrate the three remaining categories of selection, communal pooling, and forecasting.

Table 4.6.5. Adaptation strategy categories (based on Agrawal 2008, Gómez-Baggethun et al. 2012), with examples derived from transhumance on the Conquense Drove Road.

Categories	Adaptive strategy	Examples of transhumance-related TEK
Mobility	Temporal use of pasturelands	• *Dehesa* use by livestock only in winter, allowing for tree regeneration (Carmona et al., in press). • Highland pastures' use only in summer. • *Redileo,* i.e. to pen livestock at night in folds that are moved every three to five days in order to improve pastures and comply with the carrying capacity of the ecosystem.
	Flexibility in the selection of the wintering areas	• Before the incorporation of women and the rest of the family to transhumance and hence the creation of social links to a certain town, shepherds chose every year the wintering rangelands depending on pasture availability and quality, and on rangelands prices.
	Availability of an extended and well-connected network of drove roads	• Knowledge about the drove roads network protected by the State with the priority use for livestock, allowing mobility within a matrix of agricultural landscapes, urban settlements, highways and railroads. • Logistics during transhumance trip, conflict resolution with farmers, and dealing with weather uncertainties.
Diversification	Institutional diversity at different scales	• Combination between formal institutions such as NGOs or local administrations, and informal institutions such as land tenure regimes, social networks of mutual support for resources management at different scales, from European to municipal.
	Diversity of income sources	• Diversified production of meat and wool, and employments (eg. in other agrarian activities such as olive-picking in winter, shearing in spring or mushroom gathering by the end of the summer or early fall) among household members to cope with market uncertainties.
	Diverse sanitary practices	• Combination of new medicines, such as vaccines, and natural remedies. • Maintenance of no technology-dependent practices and knowledge, such as the adoption of orphan lambs, herds and pasturelands management.

Categories	Adaptive strategy	Examples of transhumance-related TEK
	Diversity of social contexts	• Know-how of transhumant families in different ecosystems and social contexts.
Selection	Well-adapted breeds	• Transhumant breeds, such as the Merino sheep, adapted to long walks and climate extremes.
Communal pooling	Common pasturelands (summering area)	• Local shepherds have the right to access common pasturelands at very low prices, what constitutes an "insurance" against increasing prices of private rangelands.
Forecasting	Interpretation of animal behavior	• According to the herds' behavior (nervousness, anxiously feeding, excessive quiet, etc.), livestock raisers usually know when the weather is going to change. • Seeing some wild species wandering around, such as toads moving upwards, indicating rain coming soon, and if walking downwards, indicating the absence of rain in the following days.

4.6.5. Discussion

4.6.5.1.Transhumance-related TEK and its holders

We identified two main categories of elements related to transhumance-related TEK: (1) TEK that had been abandoned due to obsolescence or replacement with new forms of knowledge; and (2) TEK that remained in use because it could not be replaced by any other technical knowledge, because the replacement was less effective or more expensive than the traditional practice, or because the practice was strongly linked to cultural identity. However, TEK that has seemingly become obsolete under present socioeconomic and technological conditions may illuminate the path to future scenarios. For example, rising oil prices in relation to the peak oil and the decline in energy returns on investment provide an economic incentive to resume transhumance on foot. Knowing when/how/where to walk the drove road instead of using a truck might become even more useful in this context. Second, with rising prices of imported livestock feed, transhumance to take advantage of pasture productivity becomes a more appealing option. Third, the use of dog breeds such as mastiffs that were previously raised and trained to protect herds from wolf attacks may become relevant again if large predators reappear. Other TEK remains in use, mainly because of the lack of effective substitutes. For example, shepherds apply blood from a cut on the ear to the eyes of sheep to heal keratoconjunctivitis (or *the clouds in an eye*); they also recognize their animals by the sound of their bells. These practices could be considered living evidence of TEK that has survived for centuries and remains in use.

The diversity of informants holding TEK showed rich causal relationships to the practice of transhumance. TEK holders included a few young people who were involved in transhumance; young informants who had emigrated to urban areas but continued to participate in migrations and thus remained in contact with TEK; middle-aged shepherds who drove livestock by truck but considered a return to drove road use as an alternative in times of crisis; a few people who continued the practice of transhumance on foot; and many elders who were retired or were settled and continued to raise livestock. Our classification revealed that social groups are defined by a complex combination of factors reflecting the intricacy of the current socioeconomic context underlying transhumance. The quantitative approach of the present study may have obscured the qualitative effects of identity, tradition, and other cultural values in keeping TEK: social groups might show a gradient such that people with more deeply rooted transhumance identity might have higher levels of TEK, irrespective of other sociodemographic characteristics.

4.6.5.2. Factors influencing TEK maintenance

This study identified the following main factors influencing the maintenance of transhumance-related TEK: generational change, continuing to walk the drove road, full-time dedication to livestock raising, and gender. In this section, we also discuss the role of education with reference to the results of similar studies in Spain.

Generational change

TEK scores were lower in the youngest generation than in all other generations. Gómez-Baggethun et al. (2012) found similar patterns of TEK loss in agricultural systems in Doñana, Spain, where traditional knowledge and beliefs tended to erode with market integration and mechanization. In the present study, the Use index was also lower among young informants no longer involved in livestock raising and retired shepherds. These results suggest that TEK is a function of use rather than age. Active shepherds, especially those in the mature generation, continued to use traditional practices. TEK scores were homogeneous among informants aged 36–68 years, but middle-aged informants used TEK less than those in the mature generation, indicating a breakpoint in the transmission of transhumant-related knowledge. Studies of TEK loss usually pay limited attention to whether people use that knowledge (Gómez-Baggethun and Reyes-García, forthcoming), which may limit the ability to investigate the chances for effective transmission.

TEK is mainly preserved through use and TEK that is not used is more easily lost; thus, the relative difference between TEK and its use in each group/generation can be interpreted as a proxy of the amount of remaining TEK likely to be lost (Reyes-García et al. 2007). The elderly generation in this study maintained high levels of TEK, but they no longer used it because they were retired or because the specific knowledge they held was no longer useful in present ecological and socioeconomic conditions; this knowledge is thus renewed less often and is more likely to become obsolete. Older active shepherds still used TEK, suggesting that this knowledge remained relevant even in the context of present technologies and regulations.

However, middle-aged shepherds who preserved TEK used it less often than did older active shepherds, possibly because their younger age led them to more easily incorporate innovations. Finally, the youngest generation, which became active only after the intensification that accompanied the green revolution, held less TEK and put it into practice to a very limited extent. This generation had not experienced traditional transhumance with few inputs of energy and machinery, separation from families, and extremely harsh conditions for shepherds. These intergenerational differences seem to be related more to recent historical changes than to the learning process taking place as people age: for example, formal regulations that prohibit some traditional sanitary practices based on minimal-impact surgery or medicinal plants could have been drivers of TEK loss. The level of TEK was higher in the oldest generation than in the youngest generation while no loss was observed among interviewees aged 36-68 years, suggesting that TEK loss is not necessarily associated with a failure in the mechanisms of cultural transmission of knowledge, but rather with contextual factors affecting the applicability of TEK.

What are the drivers behind the loss of transhumance-related TEK? In agreement with previous research on TEK in Spain (Ruiz and Ruiz 1989, Barrios et al. 1992, Gómez-Baggethun et al. 2010, Gómez-Baggethun and Reyes-García, forthcoming), our results suggest that declining levels of TEK are related to the abandonment of transhumance on foot due to economic development and market integration, technological change, and the enforcement of sanitary regulations. Our research also suggests that TEK loss is related to cultural changes in lifestyles. In the last five decades, Spanish agriculture and pastoralism have undergone major changes (Naredo 2004). By the 1960s, Spain had entered a period of rapid economic development that led to a massive rural exodus and the intensification of agriculture (Pineda 2001), thereby reducing the number of potential TEK carriers. The integration of Spain in the EU and the introduction of the Common Agricultural Policy accelerated this process by providing incentives for intensification (Caraveli 2000, Manzano-Baena and Casas 2010). The rural exodus and the consequent and progressive abandonment of traditional resource management practices with technification and sedentarization fostered the replacement of TEK with new forms of knowledge and practices (Berkes et al. 2000, Pilgrim et al. 2008, EME 2011, Gómez-Baggethun et al. 2012). In Spain, the loss of traditional practices accelerated in the 1980s, coinciding with low oil prices and the development of new transportation infrastructure (Oteros-Rozas et al. 2012b). Arguably, these factors are fundamental drivers underlying the failure to transmit TEK to younger generations.

This situation, however, may be reaching a tipping point. The severe economic crisis in Spain and throughout Europe, and increased production costs associated with rising commodity prices, favor a return to low-input transhumant practices, albeit hybridized with modern means (Fernández-Giménez and Fillat Estaque 2012). Given the presence of substantial pockets of TEK in the study area, partial recovery of transhumant practices has been possible in recent years and is likely to continue in the future.

Walking the drove road

The most significant factor influencing TEK maintenance was whether informants continued to walk the drove road. Experience with at least one transhumant trip by train, which entails walking the drove road for 2–5 days to reach the train station, was also related to higher TEK scores. The smallest difference between TEK and Use indexes was found among middle-aged and young informants with no familial tradition of transhumance, but who had experience with trips in which they helped family members or friends. Transhumants who traveled by truck and those who had settled but continued to raise livestock had lower TEK scores than experienced transhumants but the same average Use index. These results can be explained by transhumants' engagement in practices devoted to collectively recalling past experiences during trips, such as storytelling, interpretation of animal behavior, health care practices, searching for high-quality pastures and water, and dealing with disturbances such as unexpected fires or conflicts with local farmers. These practices and rituals serve to maintain TEK and facilitate its transmission.

Full-time dedication to livestock raising

Active livestock raising was also a key element in the maintenance of TEK. Among informants in groups A and B, who had the weakest relationships to transhumance, the associations between Use and TEK indexes were very similar, but active shepherds tended to have and use more TEK than did others. Full-time shepherds, as opposed to those who merely accompany their fathers/brothers during trips, may gain TEK by asking questions to transhumants because they share a profession. Some are even employed occasionally by transhumants to help with the herd during trips.

Gender

Men tended to have higher levels of TEK than women. However, this finding must be interpreted cautiously, given the strong gender bias in our sample selection. Very few women are fully involved in transhumance, and even fewer are officially registered as farmers; most daughters of transhumants emigrate or gain employment in other activities, and we encountered no woman involved in transhumance who had not inherited the tradition from her family or who was not married to a transhumant shepherd. This situation compromises generational renewal, as the difficulty of finding a partner who is willing to adapt to the transhumant lifestyle constitutes a social constraint for young individuals and is a clear example of agrarian masculinization (Fernández-Giménez and Fillat Estaque 2012).

Education

In contrast to the findings of other studies (e.g., Benz et al. 2000), formal education did not seem to have a significant influence on the level of TEK in the present study. This finding may be related to the standardization of education in rural Spain, which has eliminated conspicuous differences in educational level in the population; this situation contrasts with those in many other countries, where lower educational levels are found in rural areas. The children of transhumants previously remained with their mothers in the summering area during the school year. Since the 1980s, however, most transhumant families travel together; children typically begin the school year in the summering area and then move to the wintering area to complete the academic year.

Transhumance-associated TEK is not included in formal education at any level in Spain, eliminating any potential interference due to the acquisition of different types of knowledge in school. The effects of cultural identity, experiential learning through transhumance practice, raising livestock, or belonging to a certain generation seemed to be stronger explanatory variables than education in TEK maintenance. Other studies in Spain have found similar results (Gómez-Baggethun et al. 2010a, Iniesta-Arandia et al., forthcoming). However, more research is needed to further explore the relationships between TEK maintenance and education in northern European countries, where traditional practices are still preserved in contexts of largely extended formal education.

4.6.5.3.Transhumance-related TEK and adaptation to global change

Previous studies have demonstrated the relevance of traditional knowledge for resource management in different ecosystems (Berkes 1999). The role of TEK in building resilience to disturbance can be especially critical for communities that rely on ecosystem services as primary sources of provisions or income (Gómez-Baggethun et al. 2010). TEK might also serve as a reservoir of information, practices, and institutions to be drawn upon when a community confronts novel changes (Berkes et al. 2003). Examples of transhumance-related TEK identified in the CDR case study (Table 4.6.5) illustrate adaptive strategies of mobility, diversification, selection, communal pooling, and forecasting (Agrawal 2008, Gómez-Baggethun et al. 2012) that can contribute to the resilience of the social-ecological system.

Mobility is widely recognized as an important adaptive strategy used by pastoralists (Fernández-Giménez and Le Febre 2006). Some examples of mobility strategies adopted on the CDR are the *redileo*, a common practice in the *dehesas* of the wintering area, and flexibility in the annual selection of rangelands according to pasture availability and prices. Another adaptive strategy consists in diversification, as it facilitates to pool risks across the assets and resources of households and collectives (Agrawal 2008). In this case, the diversification of institutions is exemplified in local committees to arrange the use of common pasturelands, the temporal alignment of shepherds' schedules to share the trip, and the ancient transhumant association called *Mesta* (García-Martín et al 2004). Shepherds also diversified income sources from the herd, such as meat, leather and wool.

The selection of autochthonous breeds, especially those well adapted to walking long distances and to climatic extremes, is crucial for transhumance. Locally adapted livestock varieties have been largely valued as fundamental in the adaptation to global environmental change (Altieri and Koohafkan 2008, Gómez-Baggethun et al. 2012). Common resources and related institutions have been largely priced on the basis of their reliability in the face of uncertainty and perturbations (Ostrom 1990). In this case communal pooling constitutes a guarantee of access to resources, especially important under conditions of large fluctuations in rangeland rental prices, which occurs in wintering areas because of competition with other land uses such as recreational hunting and biodiversity conservation. Most pasturelands in the summering area are communal and local shepherds have the right to pooled use. Forecasting has also been recognized as an adaptive strategy to changing environments (Morton 2007).

An example of this strategy involves knowledge about animal behaviors that act as weather indicators, such as general nervousness, nervous feeding, and excessive stillness, depending on the area, season, breed, and herd. Moreover, we noticed that changes in the dates of movements were reported as consequences of adaptation to climate, such as increasing temperatures earlier in spring, and market fluctuations, such as reduced profitability forcing the practice of more than one farrowing per year.

Adaptation to global change requires response to opportunities for environmental and socioeconomic sustainability and the revisiting of past strategies that embody social and ecological memory (see Barthel, this issue) to build resilience to deal with crises (Gómez-Baggethun et al. 2012). The maintenance of mobile pastoralism and preservation of knowledge necessary to conduct those activities in a sustainable way thus seems important, not as a bucolic reminder of idyllic past times that never existed, but as a useful strategy to deal with growing challenges posed by accelerated global change. As TEK increases the capacity of social-ecological systems to deal with disturbances and maintain resource flows in changing and uncertain conditions (Berkes et al. 2000, Folke et al. 2003), we believe that transhumance-related TEK can help to build resilience enabling communities to cope with disturbances such as climate change and fluctuating market prices. Our research findings suggest that the potential for the recovery of transhumance remains. Fernández-Giménez and Fillat Estaque (2012) recently reported on the revival of transhumance in the Valley of Hecho in northern Spain. Moreover, the economic crisis in Spain seems to have triggered the return of young people to the countryside and to agrarian practices.

Our understanding of how global change may affect the livelihoods of pastoralists still suffers from substantial gaps. Mobility has always been and will continue to be an important adaptational strategy in the face of global change (Berkes and Jolly 2001, Agrawal 2008, Gómez-Baggethun et al. 2012). Understanding the factors that have made transhumance adaptive in the face of past crises can provide important insight about how to face global change under present conditions. The management of risks in food production caused by fluctuations in primary productivity and water availability is a major challenge for human populations (Ericksen 2008).

In developed countries, small-scale farmers and pastoralists can either completely disappear or play a key role in building social-ecological resilience. Emerging movements calling for agroecology and food sovereignty together with an increased demand for organic food appear to be potential niches for traditional production systems like transhumance. Nevertheless, the primary sector's loss of socio-economic prominence in developed countries leaves little space in the short term for economic activities that sustain living TEK systems, threatening the survival of important pockets of knowledge useful for the future, such as those presented here.

4.6.6. Conclusion

We found that a rich body of TEK persists among Spanish transhumant shepherds. However, a marked loss of TEK was observed among transhumants born after 1975, who held about one-fifth less TEK than did transhumants from other generations. Transhumance-related TEK is being replaced or its practice hindered as sophisticated technologies render it obsolete or provide means of saving time and effort. Our results show that transhumance-related TEK will only remain if the activity survives. When access to technological means becomes more expensive, but different mobility strategies are available, the return to traditional practices emerges as an adaptive strategy and reinforces TEK, triggering a positive feedback loop. Further research should be developed in order to provide insights on how the generational turnover for the transmission and use of TEK, could be reinforced. In particular, we suggest the analysis of: (a) formal and informal institutions sustaining or hindering the practice; and (b) gender forces influencing young people decisions about whether to be transhumant or not. The study of mobility systems such as transhumance can improve our understanding of how to increase the resilience of social-ecological systems in the current context of great socioeconomic and ecological uncertainty.

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Appendix A. Questions included in the survey and their combination for the calculation of TEK indexes

Questions included in the survey and their combination for the calculation of TEK indexes							
	TEK general	**TEK** past	**TEK** transhumance	**TEK** environment	**TEK** indicators	**TEK** sanitary	Use
1. In a herd of sheep, is it important to have goats? Why/What for?	X						
2. In a herd of sheep, what is the ideal number of males (in order to maximize productivity)?	X						
3. Which is the maximum size of a herd of sheep so that it can be driven, during transhumance on foot, by two shepherds with dogs but without horses (plus a person in charge of logistics, driving the car)?	X		X				
4. When there used to be just one birth a year per sheep in which time of the year were rams mixed with sheep (females)? Why?	X	X	X				
5. How many kg of wool does a *merino* sheep produce a year, on average? [*merino* is the local breed]	X						
6. Do you know any tricks for making a mother adopt a lamb from another sheep when her lamb has died?	X						X
7. How do you name sheep out of their teeth?	X						
8. Could you recognize, in this picture, four types of brands in the ears of the sheep? [a panel with 6 drawings was shown]	X						
9. In the past, animals used to be branded with pitch ¿do you know what materials were used to produce pitch? [If yes] ¿How was it made?	X	X		X			
10. Apart from the ear and the pitch brand ¿in which other way were sheep branded in order to avoid thefts?	X	X					X
11. Could you name five types of bells and order them from the biggest to the smallest?	X						
12. Nowadays, a bad year with none or little pasture, one can feed the animals but what did people use to do in the past? [more than 50 years ago]	X		X				
13. Could you mention two plants from the summering area and two from the wintering area that are good pastures?	X		X	X			
14. In the wintering area, when is the *saeta* good and when is it bad?	X		X	X			X

Questions included in the survey and their combination for the calculation of TEK indexes							
	TEK general	TEK past	TEK transhumance	TEK environment	TEK indicators	TEK sanitary	Use
15. What does the practice of *redileo* consist in? What is it good for? [if he/she knows] Why is the pasture better where this practice is done?	X	X	X	X			
16. In the past, when the herds needed to be pen, what material was used to make the fold out of? How have this material been changing? [if he/she knows] Why?	X	X					
17. How should a mastiff behave during daylight? And in the night? And how should it react if there is a wolf attack to the herd?	X	X					
18. What do sheep suspect when they eat a lot and look nervous and restless?	X				X		
19. When big toads are seen around, what do they indicate? Could you name (and explain) any other animal behavior that indicates environmental changes?	X			X	X		
20. Could you complete the proverb: "Rain in January..."	X		X				
21. Could you describe, season by season, a good meteorological year, for pasturelands and livestock, for transhumants?	X		X	X	X		
22. What causes *basquilla* among sheep? Do you know any natural remedy or practice to treat it or prevent from it? [*basquilla* is a disease caused by an entherotoxin produced by *Clostridium perfringens*]	X	X		X		X	X
23. Do you know any natural remedy or practice to treat mange?	X	X		X		X	
24. Do you know any natural remedy or practice to treat livestock from the deposit of fly larvae eggs into wounded tissue?	X	X				X	X
25. Do you know any natural remedy or practice to treat the *clouds in the eyes*? [*clouds in the eyes* is the common name for keratoconjunctivitis]	X	X				X	X
26. When did the trip take longer, before the trains came or now? [if he/she knows] why has this changed?	X	X	X				
27. Could you mention at least five municipalities/towns of La-Mancha region that are crossed by the CDR?	X		X				
28. If you did transhumance on foot next year, what croplands would you need to prevent sheep from feeding on?	X		X	X			

Questions included in the survey and their combination for the calculation of TEK indexes							
	TEK general	**TEK past**	**TEK transhu mance**	**TEK environ ment**	**TEK indicators**	**TEK sanitary**	**Use**
29. If you did transhumance on foot next year, what problems might you face during the trip?	X		X	X			
30. In which municipalities/towns of La-Mancha region are there more problems with water availability?	X		X				
31. Which is the traditional date for cutting the tail of the sheep? Why? [Has it changed?]	X	X					
32. What was used to be done by Saint Michael, on September 29th? Why in that date?	X	X	X				
33. What was the *zagón* and what was it used to be it made out of? And the *zaque*? [both were recipients made out of sheep and cow leather respectively]	X	X					
34. Do you know what the *somarro* is? [is he/she knows] How is it prepared? [*somarro* a way of preserving sheep meet by drying it]	X						X
35. Could you complete the proverb: "The shady size is good..."? What does the above mentioned proverb mean?	X			X			
36. Do you know the five shepherds' commandments?	X						
CRONBACHS' ALPHA	0.87	0.74	0.75	0.72	0.41	0.41	0.59

Capítulo 4.7

Vislumbrando el futuro de la ganadería trashumante a través del diseño participativo de escenarios: un caso de estudio en España.

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4.7. Envisioning the future of transhumant pastoralism through participatory scenario planning: a case study in Spain

Abstract Transhumance is a practice of nomadic pastoralism that was once common in the Mediterranean Europe. This livestock-rearing system is associated with the maintenance of cultural landscapes and the delivery of a wide range of ecosystem services. Although transhumance is still practiced in Spain on a small scale, its future is highly uncertain because of socio-economic constraints and other drivers of change. A participatory scenario-planning exercise with 68 participants, including shepherds, decision-makers, veterinarians, environmental experts, intermediaries from the wool and meat markets, and researchers, was used to envision plausible futures for transhumance and to enlighten policy-making for the maintenance of this practice along the Conquense Drove Road, one of the largest foot-based transhumant social-ecological networks still in use in Spain. Specifically, the aims were to: (1) analyse the drivers influencing the future of transhumance, (2) depict the current situation of transhumance, (3) envision future scenarios for this activity, (4) analyse ecosystem services' trade-offs between different scenarios and their effect on human well-being, and (5) provide some insights for policy-making related to the maintenance of transhumance. Four plausible future scenarios were built, each showing clear trade-offs in the delivery of 19 ecosystem services, such as food, fibre, ecological connectivity, soil fertility, air quality, fire prevention, cultural identity, local ecological knowledge and cultural exchanges, as well as the different dimensions of human well-being. As a result of the participatory process, nine management strategies were identified for the maintenance of transhumance. Priority was given to the implementation of payment schemes for ecosystem services, the enhancement of social capital among transhumants and institutional coordination, the improvement of product marketing, and the restoration and conservation of drove roads. Finally, the implications of the current reform of the Common Agricultural Policy in the European Union for the maintenance of transhumance are discussed.

Keywords: livestock rearing, Common Agricultural Policy, ecosystem services, cultural landscapes, participatory process.

4.7.1. Introduction

Pastoralism occurs over approximately 25% of the earth's land area and supports roughly 200 m households and herds of nearly one billion livestock, accounting for about 10% of the world's meat production (FAO, 2001). Pastoralist systems are considered to be a mode of production that provides subsistence products, as well as an adaptive process to natural conditions (Salzman, 2004; Postigo et al., 2008). In addition, they are increasingly acknowledged as a key tool to sustainable development (e.g., Mortimore et al., 2009). In Mediterranean Europe, pastoralism is responsible for having shaped areas of, what are termed, high nature-value farming (Baldock et al., 1993; Beaufoy et al., 1994) and for maintaining biodiversity, especially in mountain ecosystems and rural areas (Hatfield et al., 2006). Pastoralism, however, is considered one of the livelihood strategies worldwide that is most vulnerable in the context of global environmental change (e.g., Nori and Davies, 2007). Despite the acknowledged adaptive advantages of mobility-based pastoralist strategies, pastoralism is declining all over the world (Dong et al., 2011) as a result of a variety of factors that include progressive integration of animal production into the global market economy, sedentarisation policies, and institutional constraints that disadvantage nomadic lifestyles (Davies and Hatfield, 2007; Galvin, 2009; Oteros-Rozas et al., 2012a). These pressures, combined with global drivers, such as climate change and land-use change, are challenging policy-makers to safeguard pastoralism in general (Foran, 2007; Nori and Davies, 2007; Puig et al., 2011) and nomadic pastoralism in particular.

Transhumance has been a major pastoralist practice in Mediterranean Europe, evolving as an adaptation to highly unpredictable and fluctuating rainfall in order to match the grazing pressure of livestock to the availability of pasture (Ruiz and Ruiz, 1986; Blondel, 2006; Manzano Baena and Casas, 2010). Transhumance persists in some countries, such as Spain, although in a different structure and on a much smaller scale than in the past (O'Flanagan et al., 2011). However, the future of transhumant pastoralism in Spain is highly uncertain. A starting point for improving policy decisions affecting the survival of transhumant pastoralism could be by increasing policy-makers' understanding of the rationale behind transhumance and its relationship to the delivery of ecosystem services (Oteros-Rozas et al., 2012b).

Pastoral practices in Mediterranean Europe are recognized to contribute significantly to biodiversity, especially in mountain ecosystems and rural areas (Hatfield et al., 2006). Transhumance in Spain has been acknowledged for the supply of regulating services, such as connectivity and seed dispersal, fire prevention, soil fertility and biodiversity conservation, as well as provisioning and cultural services, such as high-quality meat, cultural identity and traditional ecological knowledge (e.g. Gómez Sal and Lorente, 2004; Mangas-Navas, 2004; Bunce et al., 2006; MARM, 2011; Oteros-Rozas et al., 2012a). Until now, however, transhumants have represented a "minority vote" in policy-making, which partially explains why policies for pastoralism continue to fail (Hesse and Odhiambo, 2006). To develop effective management strategies for the maintenance of transhumance, transhumants should be integrated into the policy debate.

Participatory scenario planning is a tool for combining knowledge sources, both experimental or technical, and experiential or traditional, and for bridging knowledge and policy-making (Bennett et al., 2003; Cork et al., 2005). It allows the diverse stakeholders involved to debate and enter into dialogue with the common aim of building plausible shared visions while embracing uncertainty (Peterson et al., 2003). Moreover, combined with a backcasting approach (Dreborg, 1996), such planning is an excellent means for linking ecological science to policy (Puig et al., 2011; Ravera et al., 2011; Kaljonen et al., 2012) and for providing potential management strategies to achieve desirable future scenarios and avoid undesirable ones (Dreborg, 1996; Audsley et al., 2006). Scenario planning is particularly useful in the contexts of declining trends of a system for fostering creativity and in collective thinking (Van der Heijden, 1996; Bennett et al., 2003; Peterson et al., 2003). Palomo et al. (2011) reviewed how scenarios have been increasingly adopted in environmental planning to explore a wide range of issues, such as the state of biodiversity (Sala et al. 2000), the evolution of ecosystem services and their relationship to human well-being (Pereira et al. 2005; Bohensky et al. 2006; Carpenter et al. 2006), desertification and land degradation (Kok et al. 2004), land-use changes (Jessel and Jacobs 2005), regional planning (Peterson et al. 2003) and the management of natural protected areas (Brown et al. 2001; Gude et al. 2007). Another interesting overview of existing scenario studies in the European Union is provided by Metzger et al. (2010) who, in addition, report on the Foresight Analysis of Rural Areas Of Europe (FARO-EU) project of the European Commission. Few studies, however, have used participatory scenarios to ascertain the future of pastoralism in particular, and even less in the context of Mediterranean Europe. To the best of our knowledge, the only scenario- planning exercise dealing with pastoralism, though not through a participatory approach, is the one by Heikkinen et al. (2012), who concluded that this tool could facilitate discussions between pastoralists and conservation agencies including local values, understanding and everyday practices in relation to conservation targets.

Using the Conquense Drove Road social-ecological network as a case study in Mediterranean Spain, this paper aims to envision future scenarios for transhumance that, according to past trajectories and current drivers of change, might enlighten policy-making for the maintenance of transhumant pastoralism and its associated ecological, socio-cultural and economic assets. Our specific objectives are to: (1) analyse the drivers that might influence the future of transhumance, (2) depict the current situation of the transhumant livestock system, (3) envision possible and plausible future scenarios for transhumance, (4) analyse trade-offs between ecosystem services among different scenarios and their effects on human well-being, and (5) provide some insights for the maintenance of transhumance. Finally, after drawing from the results of the participatory process, we discuss the future of transhumance in the context of the current reform of the Common Agricultural Policy (CAP) in the European Union.

4.7.2. Transhumance in Spain: historical background

Since Roman times, human populations in the Iberian Peninsula have followed the routes of wild herbivores to plan road networks used for transportation (Fig. 4.7.1). During the Early Modern Age, transhumance reached its peak in Spain, with approximately 3.5 million sheep and herds covering distances up to 700 km (Bilbao and Fernández de Pinedo, 1982) along a network of drove roads that extended over ca. 125.000 km and occupied ca. 422.000 ha (0.83% of the country) (Cazorla et al., 2008). By the end of the 16th century, the combination of an increase in population, a rise in agricultural prices and the fall of the domestic and external wool markets, caused the first crisis for transhumance. However, an increase in the demand for wool from Holland triggered a recovery in transhumance until the crisis of the Ancient Regime and the breakdown of the Spanish monopoly on the Merino breed. Since the end of the 18th century, a continuous decline in pastoralism and transhumance in Spain has been taking place (Ruiz and Ruiz, 1986; García-Martín, 2004).

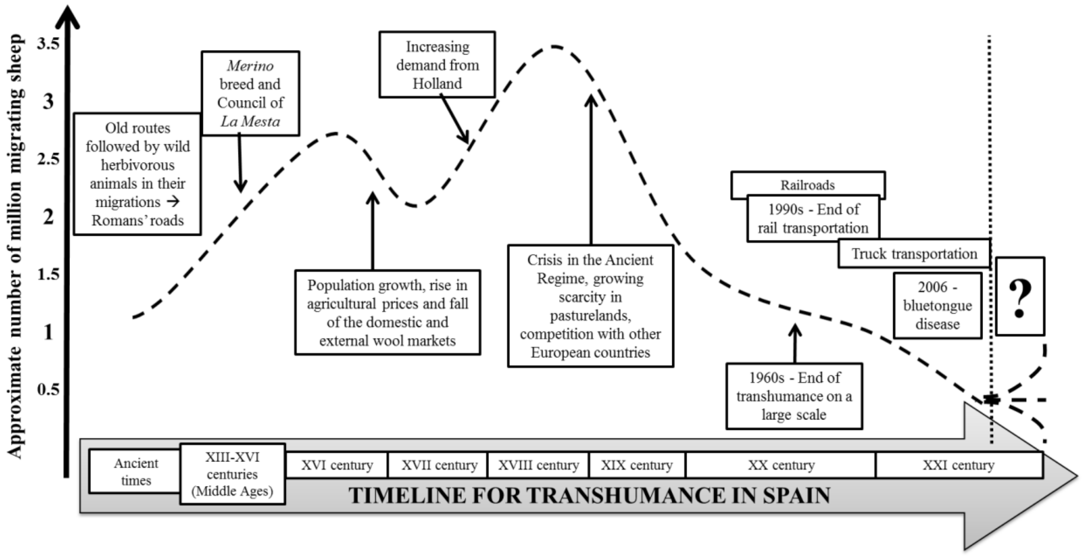

Figure 4.7.1. Time-line of important events in the history of transhumance on the Conquense Drove Road. On the y axis, the approximate number of millions of sheep is used as a proxy for transhumant activity. Data until the end of the 20th century were obtained from Ruiz and Ruiz (1986). The remaining information is from Oteros-Rozas et al. (2012a).

After 1943, the use of rail transport gradually led to the abandonment of the foot routes along the drove roads (Abellán, 1979; Bacaicoa Salaverri et al., 1993). For approximately 50 years (from the early1940s to 1993), trains were the most common means of sheep transportation but, since the 1960s with the rural exodus and the appearance of artificial fibres following World War II (Ruiz, 2001), the decrease has accelerated. The development of the Spanish highway network during the 1980s and economic growth following Spain's incorporation into the European Union (EU) made the transportation of flocks by truck the most common alternative for shepherds. During the 1980s, most shepherds in Spain completely abandoned foot-based transhumance (Ruiz and Ruiz, 1986; Manzano Baena and Casas, 2010), and in the early 1990s, the State railway company stopped the use of livestock trains (Bacaicoa Salaverri et al., 1993). O'Flanagan et al. (2011) reported a recovery in the number on transhumant sheep in three valleys of the Pyrenees since the implementation of the Common Agricultural Policy of the European Union, in the 1990s. However this trend needs to be explored in other areas of Spain as more complex drivers behind the recovery in transhumance might emerge. In 2006 after the appearance of Blue tongue disease, preventive sanitary restrictions were applied throughout Europe, thus limiting livestock movements and reducing even further the total number of transhumant livestock and shepherds in Spain.

The estimate of the number of transhumant sheep by the end of the 20th century was roughly 1.3m, and the last survey gave a value of only 270.000 transhumant sheep, of which only 10% were moved by foot (MARM, 2011). However, recent increases in fodder and oil prices appear to be encouraging some shepherds to resume transhumance on foot (Fernández-Giménez and Fillat Estaque, 2012; Oteros-Rozas et al., 2012a). The existence of a public, extensive network of drove roads that was granted legal protection in 1995 (Drove Roads Act) and connects winter and summer pasturelands has made this tentative revival possible.

4.7.3. The Conquense Drove Road as a case study

The Conquense Drove Road (CDR) is the longest drove road in Spain that is still in use by herders to move their cattle and sheep on foot. It includes a summering area, located in the eastern forests of the Montes Universales (Teruel, Guadalajara and Cuenca provinces), a wintering area, located in south-eastern Sierra Morena and the southern fields of La Mancha, and the drove road itself, which is a 75-m-wide (in most parts) corridor that crosses the Central Iberian Plateau (Cuenca and Ciudad Real provinces) for approximately 410 km (Fig.4.7.2).

The case study of transhumance on the CDR was approached from the perspective of social-ecological networks (Janssen et al., 2006), considering as a network the bio-physical and social flows maintained by the movement of herders and livestock (Oteros-Rozas et al., 2012a, 2012b). For the participatory scenario-planning exercise, the summering area of transhumance in the CDR social-ecological network was used as the core area for the study (Fig.4.7.2): it includes 19 municipalities in the Teruel, Cuenca, and Guadalajara provinces and covers 1 554 km^2. This area is one of the least populated areas in Spain (3.1 inhabitants km^2, Spanish average, 93.2 inhabitants km^2).

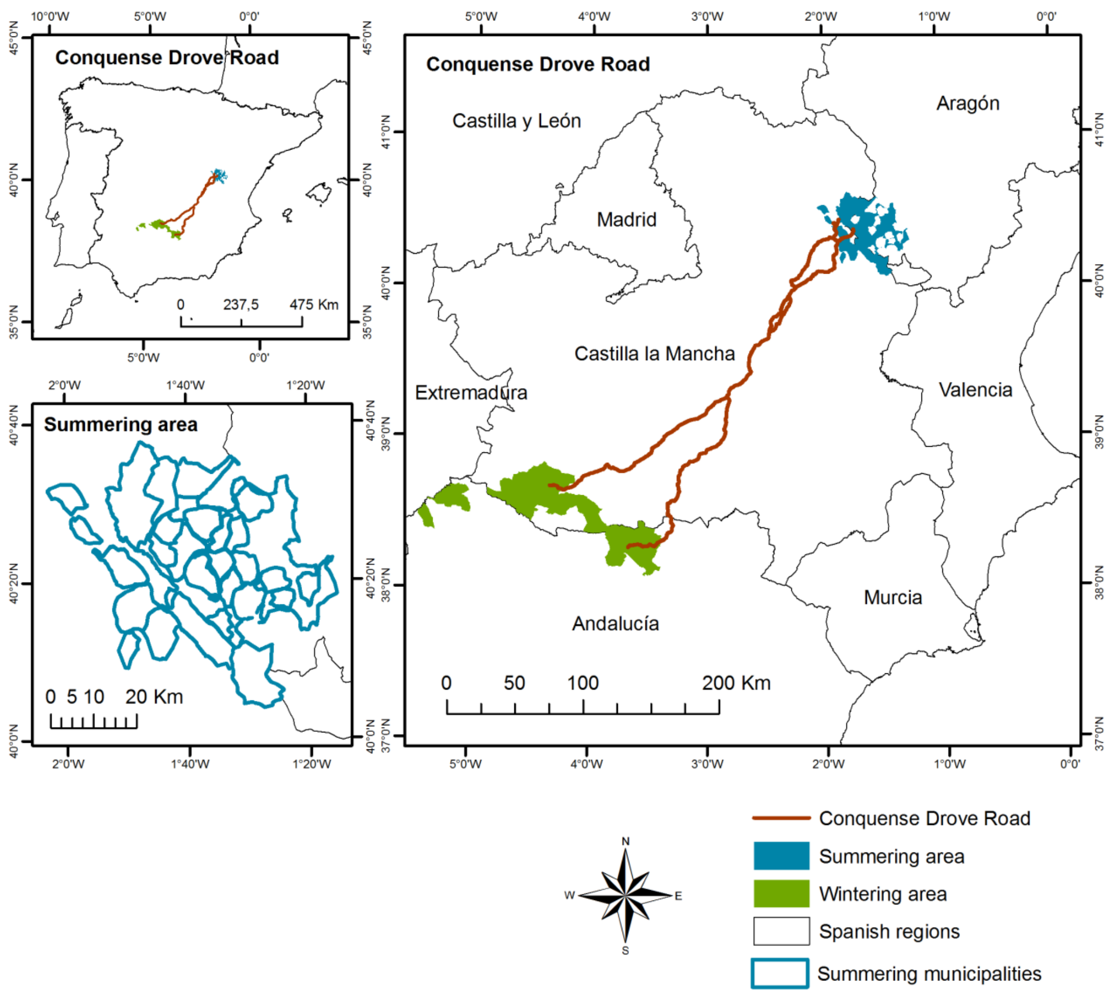

Figure 4.7.2. Map of the study area - the Conquense Drove Road (Montes Universales: Teruel, Cuenca and Guadalajara provinces).

4.7.4. Methods

A background information phase (Appendix A) was first developed in order to inform the participatory scenario-planning exercise, following the methodology of previous studies (e.g., Kok et al., 2004; Palomo et al., 2011; Ravera et al., 2011). In this phase, stakeholders were identified and prioritized using the influence and dependence matrix (Lindenberg and Crosby, 1981), which is built according to (a) their degree of influence, i.e. their effective capability and power for controlling decisions and actions within the social-ecological network, and (b) their degree of dependence, i.e. the degree to which they are positively or negatively affected by decisions and actions. According to the two axes, four groups of stakeholders were distinguished: potential beneficiaries, such as transhumant shepherds; potential counterparts, such as local administrations or the Museo de la Trashumancia (Guadalaviar, Teruel); potential opponents, such as farmers with their croplands crossed by the drove road; and other stakeholders among which potential indirect beneficiaries, such as consumer groups or environmentalists. One hundred and twenty potential participants from across Spain were selected that represented all the identified stakeholders and they were contacted by post, e-mail and telephone, or face-to-face. A total of 68 participants took part in a workshop: 36 livestock rearers (25 of which were transhumants), 13 decision-makers (e.g. from the local administration, local institutions and regional and national governments), five veterinarians, six representatives of associations (e.g. environmentalists or defenders of transhumance), five intermediaries (from the wool and meat industry), and 3 researchers.

The main part of the research consisted of a participatory scenario- planning exercise, i.e. a two-day workshop (6-7 September 2010) that was held in Guadalaviar (Teruel), the municipality hosting the majority (53%) of the on-foot-transhumant shepherds in the area. After a brief presentation of the main study objectives and the workshop agenda, participants were divided into four groups. In each group, all four types of stakeholders identified in the influence-dependence matrix were represented. Each group performed four consecutive participative techniques under the guidance of a facilitator: (1) from past to present and identification of a base-line scenario, (2) building a plausible future scenario, (3) ecosystem services and dimensions of human well-being, and (4) back-casting. The only difference between the four groups was the guidelines given for the scenario-building exercise.

<u>From past to present and the identification of the base-line scenario</u>

Each participant individually listed three critical issues that they associated with the current situation of transhumance. These issues were clustered into five aspects (i.e. economic profitability, the social situation, drove roads, institutions and ecosystem services, and other contributions of transhumance to human well-being; Appendix B) according to their similarity or affinity. These aspects were then used to guide a detailed discussion of the changes that have occurred from the past to the present and the causes of these changes. Then, a diagram of the present was depicted describing the current links between the identified aspects (Fig.4.7.3).

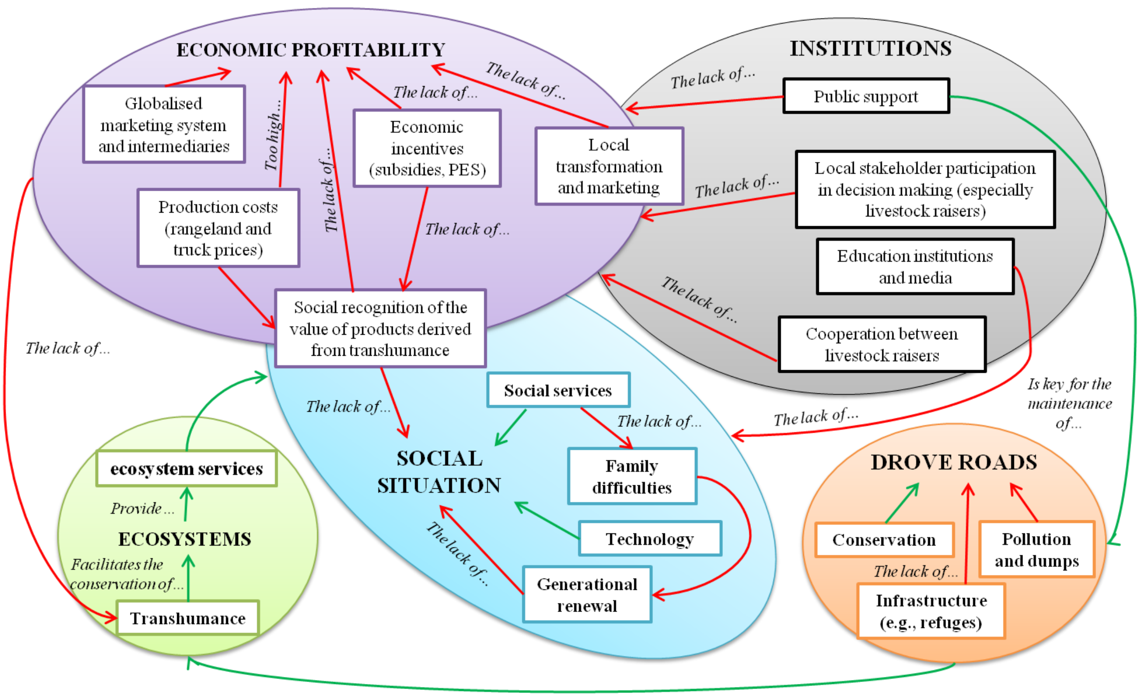

Figure 4.7.3. Baseline scenario described by participants and the relationships between aspects that characterise the present situation of transhumance in the study area. Red arrows show negative influences and green arrows show positive influences.

Building a future scenario

Each of the four groups worked with a different future scenario (Table 4.7.1).The first group was asked to build the desired scenario, an ideal scenario that is then considered as a control to compare with the others. The other three groups were given guidelines based on the main drivers of change identified in the background phase (Appendix A). Every group was requested to simulate, with maximum plausibility, how the given guidelines would affect the clustered aspects, the overall transhumance practice, and the social-ecological network, within a timeline of up to 2030. A consensus title, a summary of the storyline, and a collage were created by participants in each group.

Table 4.7.1. Four future scenarios proposed in the workshop and their corresponding guidelines.

Future Scenarios	Guidelines
Control/desired	• The most ideal, though still plausible, future scenario.
Back-to-the- future	• A national legislative framework specific for the transhumant livestock-rearing system is developed. • Sanitary regulations are modified to include specificities better adapted and more favourable for the transhumant practice. • The conservation state of drove roads is improved. • A better social acknowledgement and valuation of the products of transhumance and its related ecosystem services is gained.
Technology-driven	• Subsidies are given for the intensification of production. • There are innovative technological improvements for food production. • Incentives are given for the creation of socio-economic alternatives and employment in the area to encourage repopulation. • Recurrent sanitary problems hinder livestock movements.
Collapse	• All subsidies for livestock are removed. • The production costs increase, but wool and meat prices received by livestock rearers continue to decrease. • The quality and trafficability of drove roads deteriorates. • Young people do not become involved in transhumance.

Trade-offs among ecosystem services and the dimensions of human well-being

Each group semi-quantitatively evaluated (applying one or two arrows: upwards if the ecosystem service or dimension would grow, downwards if it would fall, or whether it would not change under the scenario) how the quality and quantity of ecosystem services would be in each scenario (Fig. 4.7.4). In particular, provisioning services were explored, i.e. food from livestock, genetic pool, feed for livestock, gathering, fibre, food from other forms of agriculture, food from hunting; regulating services, i.e. fire prevention (natural hazard), connectivity and seed dispersal, maintenance of soil fertility, tree regeneration, biological control, habitats for species, soil erosion control, air quality, microclimate regulation, hydrological regulation; and cultural services, i.e. cultural identity, local ecological knowledge, means of cultural exchange, aesthetic value, environmental education, rural tourism, recreational hunting, scientific knowledge, bull-fighting events and tranquillity/relaxation.

Important dimensions for human well-being were also assessed in each scenario by asking participants: how would the environment, society and the economy be affected in this scenario? How would society perceive this scenario? How would this scenario affect food security of the Spanish population? How would the scenario avoid vulnerability of the Spanish population in the face of the changes described in the storyline? Consensus was encouraged by the facilitators but was not enforced, and thus was not always achieved. Participants discussed the trade-offs among ecosystem services and the links between these and the dimensions of human well-being. However, most, although not all, participants at the workshop were in favour of transhumance, which probably conditioned the result of this assessment. A three dimensional plot, depicting the position of each scenario according to three axes, was created reflecting the perceived trends in (a) ecosystem services and (b) dimensions of human well-being (Fig. 4.7.5).

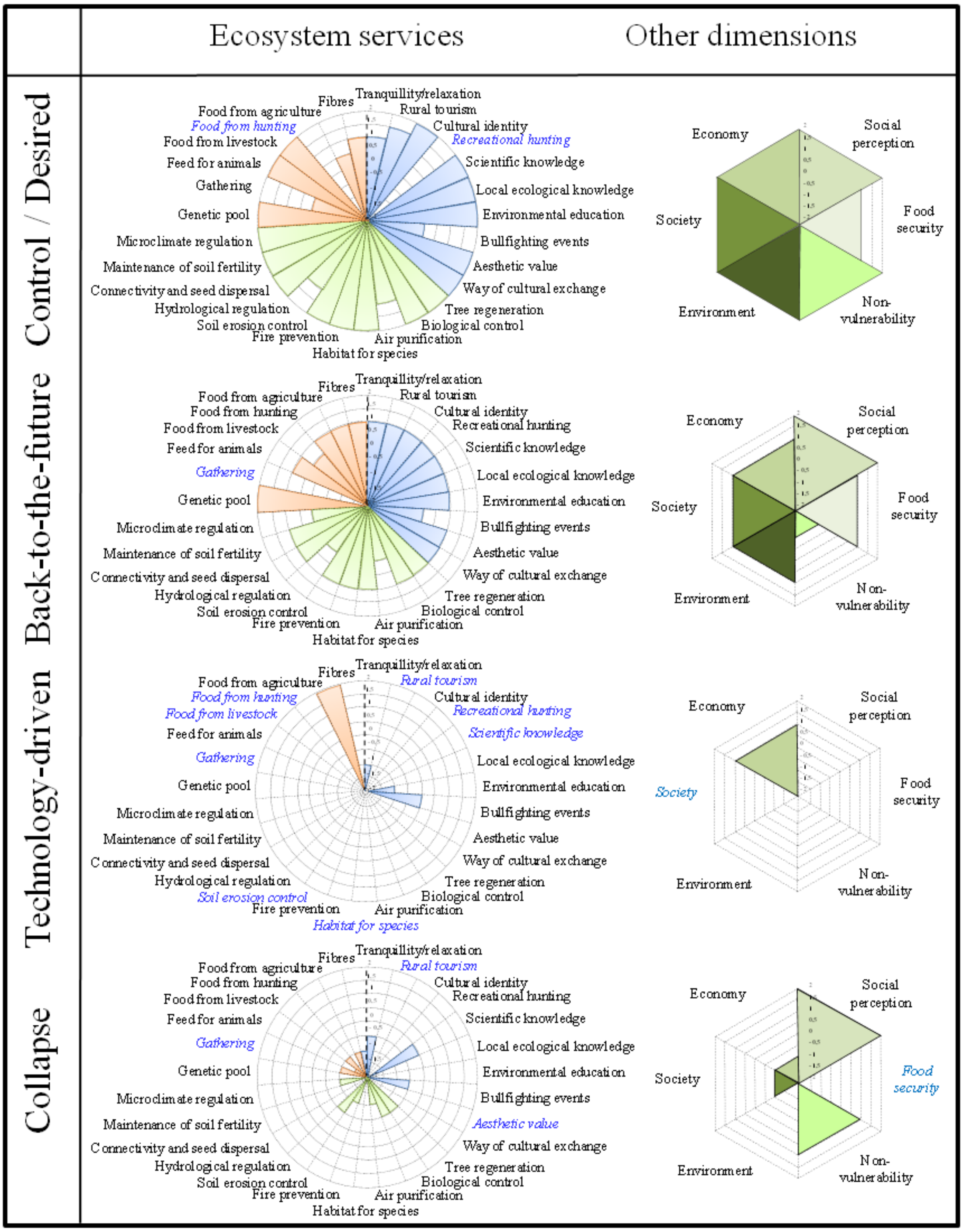

Figure 4.7.4. Trade-offs and synergies among ecosystem services and other dimensions between scenarios. The semi-quantitative evaluation was performed by applying one or two arrows: upwards if the ecosystem services/dimension would grow, downwards if it would fall, or no change under the scenario. A semi-quantitative transformation was then undertaken: "one arrow"=1, and "two arrows"=2; "upward arrows" were considered to be positive values, "downward arrows" were considered to be negative values; and "even arrows"=0. Ecosystem services or dimensions where no consensus had been reached but the direction of the arrow was the same were transformed into the average value. Those in which there was no consensus regarding the direction of the arrows were left blank (blue italic labels).

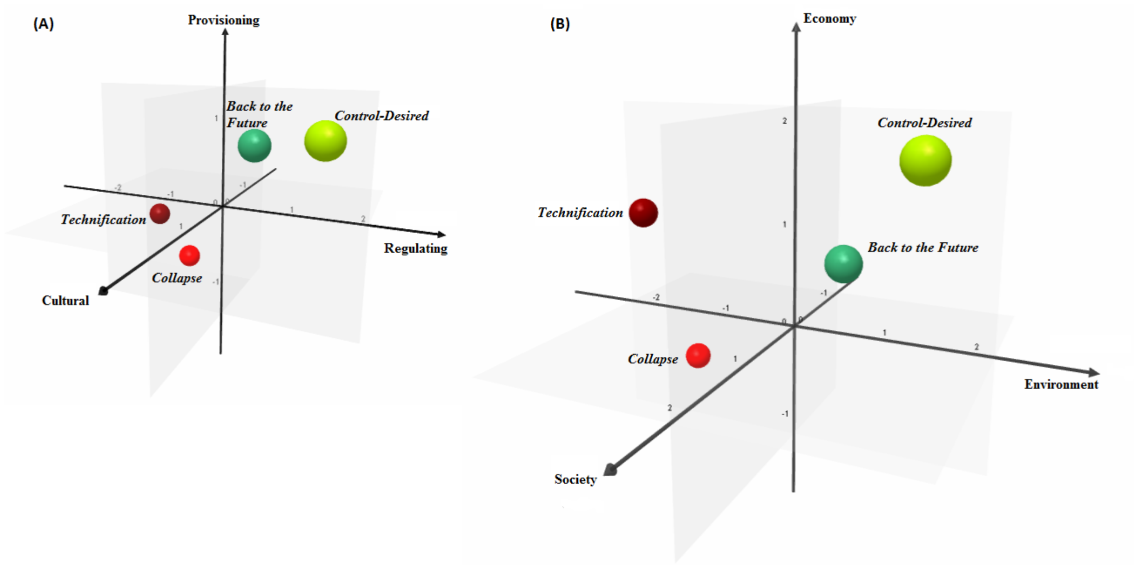

Figure 4.7.5. Three-dimensional plots of the four scenarios according to: (A) the types of ecosystem services; (B) the environmental, social and economic dimensions.

<u>Backcasting</u>

The last step consisted of proposing actions or measures to avoid undesirable features and to promote the desirable features of each scenario. First, participants (still working in four groups) discussed the undesirability or desirability of the elements described in each of the future scenarios. Afterwards, each participant was requested to individually propose at least three actions or measures that were then discussed within the groups. The proposed actions and measures were displayed on a panel that helped the presentation and discussion, and the grouping of possibly similar ideas. After this, from the complete list of actions or measures that arose in each group, each participant was requested to individually select up to five and rank them according to their priority for implementation. After the workshop, the research team processed the information obtained in the four groups and clustered all the actions and measures according to their affinity, in what were termed management strategies. Finally, the relative priority of the management strategies was calculated, according to the scores that participants gave to the single actions or measures in the ranking (Table 4.7.2).

Table 4.7.2. Main management strategies, brief description of some measures and actions proposed by participants for a sustainable future, and the percentage of support according to participants' ranking. Every participant could choose up to five measures or actions and rank them according to priority; the total points for each group and strategy was then divided by the number of participants of each group and transformed into an adjusted percentage.

Management strategies	Description of measures or actions	Support (%)
Payments for ecosystem services	Social acknowledgement of the importance of transhumance for the delivery of ecosystem services that positively affect the well-being of society through the development and implementation of state, regional or local schemes of payments for ecosystem services such as fire prevention (according to the grazing activity), or ecosystem services provided by drove roads that are still in use by transhumant sheep and cattle (e.g., habitat for species, ecological connectivity, recreational activities).	20.7
Cooperation among transhumants	Facilitation of the networks that already exist, but are weak and partly disconnected between areas, among transhumants in Spain and in the region (e.g., the coordination of periodical meetings of transhumants from different areas, and the creation of associations or cooperatives of local shepherds). On the local scale: foster cooperation among shepherds for logistic reasons (e.g., the transhumance). On a wider scale: cooperation for triggering common political and commercial strategies.	18.5
Products' marketing	T Improvements to product marketing to allow transhumance to be economically self-sustaining and independent of subsidies or payments (e.g., marketing strategies; local commercialisation; official labelling according to origin, quality or support of environmentally-sound production systems; and re-opening of local and public slaughterhouses).	17.9
Drove roads	Improvement of drove roads' quality (e.g., the installation of water troughs and refuges for shepherds, the modification of some parts of the roads and a closer control of invasion by croplands and trash) and rehabilitation of specific areas or roads.	12.8
Education and social awareness	Environmental education and strategies to raise social awareness of food consumption patterns.	10.5
Institutions and public administration	Improvement of coordination among institutions (e.g., avoid double paperwork and incoherence between sanitary legislation, landscape planning, infrastructure development and conservation policies; coordination between regional governments to respond and adapt to nomadic family lifestyles; unification of transhumance management with a state data base and assistance service; increased control over the failure to comply with the Drove Roads Act; improvement of local stakeholder participation; creation of the figure of an "Ombudsman" for transhumant shepherds).	6.8

Management strategies	Description of measures or actions	Support (%)
Training	Development of educational tools and programs for the empowerment, renovation and generational renewal of shepherds, livestock-rearing and product transformation and marketing (e.g., shepherds schools, formal education courses on extensive livestock rearing in general and transhumance in particular and renovation courses for current stockmen).	6.6
Other economic supports	Development and implementation of direct and indirect subsidies or economic supports (e.g., for the support of rural employment aiming at avoiding rural exodus; incentives for young people willing to start a livestock-rearing farm; and positive fiscal measures that would recognise the difficulties and costs of maintaining two homes).	0.6
Other measures	Social measures to facilitate life for transhumants families and schooling for transhumants' children; introduction of other complementary commercial activities, such as mushroom gathering, artisan works with wool or leather, or transformation industry; investment in research that would support decision-making; simplification of the sanitary regulations; recognition and rehabilitation of the cultural heritage associated with transhumance as a living tradition and not only as a bucolic tradition; and improvement of public control over rangeland prices and on the formalization of rent contracts.	2.3

4.7.5. Results and Discussion

<u>Characterizing past changes and their drivers up to the present</u>

The transitions and changes to transhumance in the last century were structured into five aspects: (1) economic profitability, (2) social situation, (3) drove roads, (4) institutions and (5) ecosystems, ecosystem services, and other contributions of transhumance to human well-being (Appendix B).

According to the participants, during the last four decades, there has been a transformation from a family subsistence economy to a market economy that has challenged the economic profitability of raising livestock. The industrialisation of food-chains appeared hand-in-hand with the globalisation of markets with a loss of price control by producers and with competition from low-cost imported products. Participants stated that subsidies coming from the Common Agricultural Policy in the late 1980s and early 1990s promoted change in local economies and the settlement of transhumants.

Concomitant reforms in international agricultural policies resulted in a decline in the percentage of the Producer Support Estimate in the EU from 37% at the end of the 1980s to 18% in 2010 (OECD, 2011).While in the past, a small herd of 200 sheep was enough to sustain a four-member family, the typical herd size today ranges from 600 to 900 sheep. Similar trends have been reported by Marini et al. (2011) and Rescia et al. (2008). In terms of the social situation, the main change has been a rural exodus to urban areas during the 1970s-1990s. There has been a tentative reversion because of the current economic crisis, an increasing bucolic vision of rural livelihoods (EME, 2011; Martín-López et al., 2012) and the global process of re-peasantisation (van der Ploeg

2008). In the past, shepherds were poorly regarded by society, but their job was deemed to be useful for the community and their knowledge was transmitted to young people, ensuring generational continuity. Most shepherds were formerly employed by livestock owners and were allowed to herd their own sheep together with those of the owners. Today, although shepherds are the owners of the herds and their quality of life has improved, it is still a job that is poorly acknowledged by society and is unappealing to most young people (Marini et al., 2011).

In relation to drove roads, the biggest change was the approval of the Drove Roads Act of 1995 (Ley 3/1995, 1995) that legally protected the drove roads as a public good and recognised their priority use for herding animals. During the period in which livestock trains were used, drove roads were under-used. The regrouping of lands for agrarian industrialisation during the second half of the 20th century often altered the routes and narrowed the roads because of invasion by croplands at their sides. Today, water access is scarce and uncertain, only a few shelters are left, and alternative uses, such as recreational activities, hunting, or dump accumulation, frequently interfere with livestock grazing.

Regarding the issue of institutions, increased legal and administrative complexity was largely discussed. In the past, strong farmers' institutions would defend the interests of the sector, and regulations (especially sanitary) were homogeneous at a national level. Participants claimed that today there is incoherence and interference between institutions at different organisational scales; much of the decision-power is located at an autonomic (regional) level, and agrarian syndicalism remains unconcerned with transhumant problems. There was significant agreement over the fact that regulations have been developed in a top-down manner, with little participation from local stakeholders and an increasing loss of political weight of the rural world in favour of the urban.

Regarding environmental aspects, participants indicated that in the past, there was less concern over environmental issues and that environmental values related to transhumance were less visible to society. The decrease of transhumant pastoralism had negative consequences on the environment, such as an increase in the frequency and extent of fire-hazards. Today, even if there is more awareness regarding the positive effects of extensive farming for conservation and human well-being (eg. Norris, 2008; EME, 2011), there remains little social or economic acknowledgement.

In general, the baseline scenario represented several deficiencies and malfunctions of the interactions between the most important elements of transhumance (Fig. 4.7.3). The only links considered to be positive were the institutional protection of drove roads, in addition to the positive influence of drove roads and transhumance on the supply of ecosystem services. The improvements in social services and technologies were also identified as positive assets.

Envisioning possible futures: scenarios

The four scenarios included: (1) Control/desired, (2) Back-to-the-future, (3) Technology-driven, and (4) Collapse (Table 4.7.1). These titles were not conveyed to the participants (scenarios were referred to only by the numbers) to avoid biasing the results of the following steps. A brief synthesis of each of the four future scenarios is presented below. The storylines were used to design illustrations depicting the most important features characterizing each scenario (Appendix C), except for the Control/desired scenario, which was developed as a control for the other three.

Control/desired scenario

Transhumance is increasingly appreciated by society: wool is demanded by the national textile industry, local traditions and knowledge are recovered and the commercialization of meat takes place in fair trade and local networks. Transhumant shepherds cooperate with one another, and their job is officially recognised by the State and transmitted through professional training in which new skills (e.g., marketing and accounting) are imparted. Drove roads are maintained and improved with the needed infrastructure. In addition, the appropriate preservation of the drove roads allows other complementary and respectful uses from which a larger portion of the local population can benefit. This situation triggers generational turnover with trained young people who are socially and economically motivated. The name participants gave to this scenario was "With traditional taste, walking the drove road".

Back-to-the-future scenario

Society, citizens and the government all recognise the importance of transhumance to Spanish cultural identity and for the delivery of ecosystem services; drove roads are, therefore, well preserved and used by herds and other people who benefit from complementary recreational uses. A public acknowledgement of transhumance's values emerges, in addition to a serious commitment to its support. The commercialisation of transhumant products grows in quantity, maintaining high quality levels. The relationship between producers and consumers becomes narrower, which benefits transhumants both economically and emotionally and helps to bridge the gap between the urban and rural worlds. This support is translated into employment opportunities and allows transhumance to be economically viable for new generations. The current high level of unemployment in Spain is an opportunity to return from urban to rural contexts. Governments are forced to pay attention to training in rural crafts. The modernisation of rural society is enhanced, but the main rules of extensive livestock rearing systems are kept and made compatible with new renewable and local-scale technologies. The reinforcement of tourism in the area completes the picture of rural development. Participants named this scenario "Transhumance moves".

Technology-driven scenario

Under the conditions provided for in this scenario, shepherds stay the whole year in their villages of origin. Transhumance disappears and is replaced by intensive and highly technical livestock rearing systems, contributing to the stemming of rural depopulation and improving social services. Although meat production increases, people perceive that there is a significant loss in animal welfare and meat quality. Despite the economic benefits, small family farms become more vulnerable to shifts in international markets and medium-large meat-producing companies. The landscape of the summering area changes as intensive productive systems can induce water and soil contamination, and accumulated dead forest material increases the frequency and extent of fire hazards. Large wild herbivores proliferate due to reduced competition from livestock. Unused drove roads are invaded by adjacent croplands and human infrastructure. Although a decline of biodiversity follows the disruption of ecological connectivity provided by drove roads, some parts are preserved as routes for ecotourism. The lifestyle of the transhumant shepherd vanishes along with the associated cultural identity and local ecological knowledge. The name participants gave this scenario was "Shepherds do not depart anymore".

Collapse scenario

Under the guidelines for this scenario, the economic viability of rearing livestock soon vanishes. Retiring shepherds do not have anybody to whom to transfer their herds; thus, extensive livestock rearing and transhumance in particular are largely abandoned (only small groups maintain some livestock for subsistence). The accumulation of flammable biomass in the neglected forests rapidly increases the risk of devastating fires and, therefore, inducing considerable changes in ecosystems and biodiversity. Unused drove roads are transformed for other land-uses, and the remaining areas surrounding the cities and tourist sites are converted for recreational uses. In the short term, there is an increase in hunting, but it is soon abandoned because of the progressive loss of habitat for game species. The population also leaves the area because there are few employment opportunities, leading to reduced social services and the fostering of a feedback loop of abandonment. Even if short-term hunting tourism reinforces the local economy, the transformation of the landscape relegates the area to a few villages with interesting architectural features; these villages, however, soon lose their interest, becoming "dead villages". Based on an anonymous traditional Spanish poem, participants named this scenario "Transhumant, there is no way".

Trade-offs among ecosystem services and the dimensions of human well-being

The trends of ecosystem services and the dimensions of human well-being under the four scenarios are presented in Fig.4.7.4. The scenario Back-to-the-future was the most similar to the Control/desired scenario and ensured the widest diversity of ecosystem services. However, in the Collapse and Technology-driven scenarios, the delivery of ecosystem services would be jeopardised. More precisely, in the Technology-driven scenario, there appeared to be a clear trade-off between the ecosystem service of food from agriculture and the other services: this trade-off was considered as likely to increase because of the invasion of unused drove roads by intensified croplands. For regulating services, the most auspicious scenario was the Control/desired, followed by the Back-to-the-future scenario. In the Technology-driven and the Collapse scenarios, regulating services suffered deterioration as did almost all ecosystem services. In the scenario Back-to-the-future, the genetic pool showed a particular increase because of the special interest in the recovery of local livestock breeds. Among cultural services, a similar pattern was found as that for regulating services except for the ecosystem service related to bull-fighting, as it was perceived that the type of cattle used for this purpose could still be maintained in the dehesas of the wintering areas and would always be economically profitable. In addition, an opportunity for gaining scientific knowledge in the Collapse scenario was expected because participants stated that the new ecological dynamics and landscapes would attract researchers.

The other dimensions approached in relation to human well-being showed the same pattern as that for ecosystem services: the Control/desired and Back-to-the-future scenarios were the two most positive scenarios. This fact reflects the existing match between ecosystem services and human well-being. However, it is notable that participants considered the Back-to-the-future scenario as being one of the most vulnerable scenarios, even if it was positively perceived by society. Given that the evolution of the Collapse scenario would allow the population to adapt to the new landscapes and opportunities in the cities and, therefore, allowing the opportunity for social and ecological reorganisation, this scenario was considered both positively perceived by society and not very vulnerable. The Technology-driven scenario was the most negative and vulnerable except from an economic perspective.

According to the "three-dimensional" analysis (Fig. 4.7.5) of the scenarios in terms of the types of ecosystem services (Fig. 4.7.5A) and the economic, social and environmental dimensions (Fig. 4.7.5B), the most positive and similar scenario to the Control/Desired was the Back-to-the-future scenario except for the economic dimension, in which the Technology-driven scenario was closer to the Control/desired.

What is the future of transhumance in the 21st century?

Participants identified 66 actions and measures for preserving transhumance that were grouped into nine management strategies (Table 4.7.2). The implementation of payments for ecosystem services provided by transhumance was the strategy most largely supported by participants (21%). The second set (19%) of strategic measures included different methods of enhancing the cooperation among transhumants to gain more visibility and empowerment. The improvement of product marketing to allow transhumance to become, in the long term, economically self-sustaining and independent of subsidies or payments was the third most supported strategy (18%).

Transhumance has been recognised as a practice that remains relevant and that could be revived in the face of changing economic and social conditions (Herzog and Bunce, 2004; Rescia et al., 2008; Fernández-Giménez and Fillat Estaque, 2012; Oteros-Rozas et al., 2012a) but what future can be identified for transhumance in Spain in the 21st century? In some areas short livestock movements between neighbouring lands, known as “transterminancia” or “transtermitancia” in Spain, might be more socially feasible than long-distance transhumance. However, the bio-climatic conditions of the Montes Universales (summering area; Fig. 4.7.2) give very little chance for the availability of winter pastures in neighbouring areas. Under two of the three proposed scenarios, transhumance would disappear in Spain in the next 30 years. However, the Back-to-the-future scenario was considerably similar to the Control/desired scenario and resulted in a recovery of transhumance.

The scenarios served in helping to identify and discuss management strategies, mainly in two ways. Firstly, the elaboration of the storylines allowed reflection about possible decisions (e.g., landscape management, bottom-up organization and legislation) and their social, economic and ecological consequences in the future. Secondly, the valuation of the characteristics of each future scenario as desirable or undesirable facilitated the elaboration and discussion of actions that would promote the positive aspects and avoid the negative ones. Some of the management strategies, measures and actions aimed at transhumance conservation are discussed below.

Transhumance and ecosystem services

While agro-ecosystems are recognised for their capacity to deliver some ecosystem services (e.g. Millennium Ecosystem Assessment, 2005; Power, 2010), trade-offs among ecosystem services frequently emerge and intensive agrarian practices might also be responsible for habitat loss and degradation, fragmentation, excessive nutrient loads and, correspondingly, the reduction of some other ecosystem services (e.g. Foley et al., 2005; McIntyre et al., 2009; CBD, 2010). Meanwhile, public agricultural policies have had a decisive influence on agricultural land management with important effects on biodiversity conservation and maintenance of ecosystem services (e.g. Norris, 2008; McIntyre et al., 2009; Marini et al., 2011; García-Llorente et al., 2012). Since the late 1980s in the European Union, the Common Agricultural Policy has been the most important agricultural policy mechanism influencing agricultural landscapes and the largest agriculture support system worldwide.

Regarding transhumance, although some authors have discussed about the positive contributions of the Common Agricultural Policy to transhumance practices (e.g., 'Flanagan et al., 2011), in this case study a two-fold negative effect of the Common Agricultural Policy was highlighted by participants: the enlargement of flocks had hindered mobility and the rural development strategies included support measures for the settlement of rural populations (e.g. financing farmers to develop indoor livestock systems), especially in less-favoured areas, that have indirectly encouraged sedentarisation. The European Parliament notes that "the market has failed to [...] reward farmers for protecting the environment and other public goods" and has therefore called for the provision of "proper economic incentives for farmers to optimize the delivery of ecosystem services" (European Parliament, 2010). Accordingly, Plieninger et al. (2012) argued that past agri-environmental schemes of the Common Agricultural Policy share most features of payment for ecosystem services (PES) but proposed an improved set of key features in paying farmers for ecosystem services within the current reforms being proposed to the Common Agricultural Policy for the period 2014-2020.

The expectations surrounding the results of this reform and its implementation were remarkable during the discussion of the scenarios. A marked difference was found in the social perception of subsidies and payments for ecosystem services: while subsidies were largely regarded as a necessary income source for economic sustainability of the European agriculture sector within the global market, payments for ecosystem services were perceived as a recognition by society of the important environmental public goods that extensive agriculture practices contribute to provide. Thus, the precise identification, characterisation and evaluation of such ecosystem services, together with participatory analysis of ecosystem services and environmental, social and economic trade-offs, can be of great interest to informing decision-making processes and raising social awareness (Oteros Rozas et al., 2012b).

In particular, transhumance in Spain has been acknowledged with regard to its importance in the delivery of ecosystem services (e.g., MARM, 2011; Ley 3/1995, 1995; Fernández-Giménez and Fillat-Estaque, 2012; Oteros-Rozas et al., 2012a). The integration of the ecosystem services approach into the support strategies of the new Common Agricultural Policy could facilitate the recognition of the ecological and socio-economic interest of preserving transhumance (Rescia et al., 2008). Social acknowledgement of the importance of transhumance for the delivery of ecosystem services that positively affect the well-being of society could be gained through the development and implementation of national, regional or local schemes of payments for ecosystem services, such as fire prevention, consumption of potentially flammable biomass, or ecosystem services provided by drove roads that are still in use by transhumant sheep and cattle, such as habitat for species, or recreational activities.

In some contexts, the implementation of payments for ecosystem services schemes, however, may generate new forms of inequalities at a local level between those who are willing or able to transform or adapt their practices guided by such schemes, and those who will not or cannot do so (Heikkinen et al., 2012). Decision makers should therefore be cautious in this regard and research should be developed at local scales before implementing payments for ecosystem services.

Operationalizing management strategies: social capital and institutional co-ordination

Living in marginal areas, having detailed knowledge of the landscapes in which they live and enjoying relative freedom of movement, pastoralists have been largely autonomous. However, this position is a disadvantage in the face of globalisation, as there is little association between shepherds, which has led to under-representation within international and national fora and, therefore, little visibility within decision-making processes (MARM, 2011). At large organisational scales, pastoralists lack the knowledge, capacity and resources to fight for their own causes (Hesse and Odhiambo, 2006). They are frequently unable to challenge the perceptions that the rest of society has of them or transmit the rationale underpinning their livelihood system in the current globalisation context. The few stockmen associations in Spain are focused on the defence of certain livestock breeds or the commercialisation of their own regional products, rather than on political action.

The need to support transhumants' organisations was raised during the workshop. Support is crucial for developing the political leverage necessary to effect policy change, which is a complex and long-term process that must be driven internally (Hesse and Odhiambo, 2006). The facilitation of already existing but somehow weak and partly disconnected networks of pastoralists, the coordination of periodical meetings of transhumants from different areas, or the creation of local cooperatives, were among the suggested strategies for reinforcing transhumance-related social capital, coordinating commercial strategies and improving their power-position in policy-making fora. On the contrary, at the local organisational level, transhumants show important social capital, as they support a strong network of cooperation to maintain foot-based transhumance.

Pastoralists with the strongest social capital (e.g., large transhumant families in which members help one another) have proven to be the most capable of withstanding disturbances (Galvin, 2008; Oteros-Rozas et al., 2012a). Because social relations and social networks are the glue that holds together adaptive governance (Folke, 2006), the recovery of foot transhumance will be possible only where a strong network of mutual support between pastoralists is maintained (McCay, 2000). However, none of the previously proposed or forthcoming strategies are likely to succeed if decision-making processes continue to follow a top-down dynamic. Stakeholder participation in environmental decision-making processes has been largely claimed for its benefits [see Reed (2008) for a review]. Participants suggested the implementation of stable participatory round-tables for landscape management where local stakeholders would participate thoroughly in co-management and decision-making together with other stakeholders similar suggestions were made by Rescia et al. (2008). Coordination and a commitment to consistency between policies at different scales were also demanded.

Incoherence between sanitary legislation, landscape-management plans or infrastructure development and conservation policies is common across and within policy scales. Two interesting specific measures for transhumance at a national scale were suggested in this regard: the unification of transhumance management at a national scale and the creation of an "ombudsman" of all transhumant shepherds who would provide legal assistance and information.

Finally, an essential pre-requisite for self-determination of transhumants is building their individual and collective capacity to better understand the dynamics of their own livelihood system in relation to their broader environment (Hesse and Odhiambo, 2006). In this context, the development of educational tools and programmes for the empowerment, renovation and reinforcement of generational turnover of shepherds was largely demanded. The improved knowledge will enable pastoralists to identify their own solutions to current problems according to their values and priorities, speaking in an informed and authoritative manner on policy issues of their concern. Moreover, within uncertain and fluctuating markets, knowledge and skills related to the marketing of their products would also provide them with key tools against vulnerability in the face of global markets.

Price and value: economic sustainability through the market valuation of products

The evolution of the market demand for pastoralists' products shows both an appreciation and depreciation curve (MARM, 2011). As a country develops, there is a first phase in which the products lose market value and, as long as the country grows in economic terms and intensification of production increases, there can be a complete loss of pastoralist systems. However, an increase in meat consumption occurs concurrently, opening a window for pastoralists (MARM, 2011). In further phases of economic development, some consumers change their preferences to high quality products, preferring products with an added value according to their cultural or environmental production contexts (MARM, 2011; Kneafsey et al., 2012). This tendency can stimulate the market for local and traditional products, which is also suggested by Giupponi et al. (2006), and shepherds can become more competitive against intensive production systems. Such trends are currently being perceived in Spain, where there has been an enlargement of consumer cooperatives demanding high-quality local products.

Accordingly, several measures were proposed within the workshop that would make pastoralists economically self-sustained and independent of subsidies or payments. The commercialisation of meat within local networks and markets could be fostered by a commitment of support from local restaurants and consumers' cooperatives. The re-opening of local and public slaughterhouses was suggested to facilitate a local commercialisation network, to create local employment, and to reinforce the sovereignty of producers by making them less dependent on intermediaries. Participants also recognised the need for legitimation [as in other studies, e.g., Kneafsey et al. (2012)] and suggested that recognition could be gained by official labelling according to origin, quality or support of an environmentally-sound production model, e.g., Traditional Specialities Guaranteed of the European Union.

Finally, the development of awareness campaigns about the contribution to social and environmental sustainability of extensive production systems and the organoleptic reasons behind the different colour of the meat (redder) was proposed. Most of the actions proposed would be consistent with the “public intervention” scenario reported by Metzger et al. (2010).

Drove roads: a critical public good

Drove road networks are widely recognised for their natural value (Gómez Sal and Lorente, 2004; Mangas-Navas, 2004). The Stock Route Network in Australia (Lentini et al., 2011) and the network of drailles in France (Biber, 2010) are two examples found in other developed countries. However, Spain constitutes a unique case, as the largely extended network of drove roads was granted legal protection by the Government (Drove Roads Act, Ley 3/1995) for the priority use of herding animals. However, this regulation is not always observed by private and public users, giving rise to abuses and misuses. Participants suggested an increased control over failures to comply with the Drove Roads Act and the implementation of more severe punishments for those actions that erode the quality of drove roads. In addition, some small interventions were widely demanded by participants to improve the quality of the drove roads for herds and shepherds, such as by the installation of water troughs and refuges, which could possibly encourage more shepherds to use them.

4.7.6. Concluding remarks: transhumance at the crossroad

The European Commission is currently debating the reform of the Common Agricultural Policy for the period from 2014 to 2020, a process that offers a unique opportunity for a transition from the current policy to one based more on the efficient delivery of ecosystem services from agricultural land (Plieninger et al., 2012). If this was to be the case, transhumance could be a target activity on behalf of its contribution to the maintenance of ecosystem services (Fig. 4.7.4). The European Commission (2010) has identified three challenges to be addressed by the new Policy: environment and climate change, maintenance of viable rural areas and food security. The relevance of transhumance's maintenance of the environment and as an asset for social-ecological resilience building in the face of global environmental change has already been acknowledged (Oteros-Rozas et al., 2012a).

Transhumance has traditionally allowed for the maintenance of rural populations in mountainous areas where any other livelihood would have been impossible. Regarding the third challenge, the controversies over how to confront food security remain serious. While there is a call for satisfying a 70% increase in world food demand by 2050 (Burney et al., 2010), some voices have argued that most famines are caused by deficits in food distribution, rather than by insufficient food production (Fischer et al., 2011). The United Nations Rapporteur has recognised that agro-ecology and food sovereignty models might better fulfil the food needs of the populations (De Schutter, 2010). In this sense, transhumance is a small-scale yet productive system that could provide meat under these paradigms. In fact, the future scenarios under which transhumance survived were considered by participants to enhance the population's food security (Fig. 4.7.4), which is consistent with Krätli et al. (2012) who reported on the role of pastoralism in food security under global climate change.

Exploring past changes and the responses of the social–ecological network has helped in the understanding of the evolution and structure of present transhumance and has, therefore, allowed the envisioning of possible future scenarios. In the current context of global change and uncertainty, the maintenance of transhumance seems particularly appealing. For this, the implementation of payments for the ecosystem services that it delivers, the revision or restructuration of related institutions, and the development of marketing strategies aimed at increasing the prices received by transhumants for their products, are the most critical strategies. In Spain, transhumance has survived disturbances of diverse origin and magnitude without losing its main essence and functionality, thus showing it to be a highly resilient system (Oteros-Rozas et al., 2012a).The challenge is to develop proactive and adaptive co-management strategies that, while embracing uncertainty, ensure a diverse flow of ecosystem services and the survival of rural livelihoods such as transhumant pastoralism.

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Appendix A

Background information used to design the participatory scenario planning

To design the workshop for participatory scenario planning, a background information phase was necessary (Ravera et al., 2011). To identify the ecosystem services associated with the transhumance social-ecological network, a literature review and 58 semi-structured interviews with key informants were performed (February to September 2009, Oteros-Rozas et al., 2012).

Using the interview data, relevant stakeholders for transhumance in this area were identified, and a questionnaire was developed to obtain quantitative data on ecosystem services and drivers of change. The questionnaire was completed by 416 informants through face-to-face interviews in 39 municipalities throughout the complete social-ecological network of the CDR (May 2009–March 2010). A panel with photographs of the ecosystem services was used in the survey to illustrate ecosystem services (Gómez-Baggethun 2010; Martín-López et al. 2012). The questionnaire included the following two sections among others. First, it was asked 'If transhumance on foot disappears, which (if any, maximum three) of the listed ecosystem services do you think would be lost or degraded?' Informants were invited to give a score from 1 (slightly degraded if transhumance disappears) to 4 (completely lost/degraded if transhumance disappears) for each of the options selected (see Table A.1. for the list of ecosystem services and the perceived importance). Second, participants were given a list of 'Important factors/dimensions that will most likely influence the future of transhumance', from which the informants selected the four that they considered to be most relevant for the future of transhumance (Table A.2.)

Table A1. Social perception of ecosystem services specifically associated with the existence of transhumance. "Frequency" is the number of interviewees that selected the ecosystem service as possibly lost/degraded if transhumance disappears; "%" is the percentage of the sample considering that the ecosystem service would be lost/degraded if transhumance disappears; "Mean" is the mean score (ranging from 1, "slightly degraded", to 4, "completely lost/degraded" if transhumance disappears); and "SD" is the standard deviation of the mean (total *N*=419).

Type of ES	Ecosystem services	Frequency	%	Mean	SD
Provisioning	Food from livestock	163	38,90	2,86	1,08
	Manure	63	15,04	2,30	1,12
	Genetic pool	56	13,37	2,59	1,16
	Feed for animals	45	10,74	2,36	1,03
	Gathering	18	4,3	1,83	0,92
	Fibres	16	3,82	2,25	1,00
	Food from agriculture	12	2,86	2,17	1,19
	Food from hunting	7	1,67	2,14	1,07
	Products from apiculture	7	1,67	1,86	0,90
	Wood and timber	3	0,72	2,33	1,15
Regulating	Fire prevention (natural hazard)	121	28,88	2,93	1,13
	Connectivity and seed dispersal	120	28,64	2,38	1,04
	Maintenance of soil fertility	94	22,43	2,62	1,02
	Tree regeneration	88	21	2,40	1,08
	Biological control	50	11,93	2,40	1,09
	Habitat for species	49	11,69	2,49	1,12
	Ditch maintenance	43	10,26	2,00	1,10
	Soil erosion control	39	9,31	2,41	1,02
	Air purification	22	5,25	3,00	1,11
	Pollination	21	5,01	2,19	1,21
	Microclimate regulation	18	4,3	1,89	0,90
	Hydrological regulation	5	1,19	2,60	0,89
Cultural	Cultural identity	122	29,12	2,66	1,08
	Local ecological knowledge	109	26,01	2,53	1,18
	Way of cultural exchange	103	24,58	2,83	1,15
	Aesthetic value	50	11,93	2,10	1,02
	Spiritual value	45	10,74	2,31	1,06
	Environmental education	25	5,97	1,88	1,09
	Rural tourism	23	5,49	2,00	0,95
	Nature recreation activities	21	5,01	1,81	0,93
	Recreational hunting	15	3,58	1,80	0,86
	Scientific knowledge	12	2,86	2,33	1,07
	Bullfighting events	8	1,91	2,38	1,30
	Tranquillity/relaxation	8	1,91	3,13	1,13

Table A2. Important factors on the future of transhumance. "Frequency" is the number of interviewees that selected the factor; "%" is the percentage of the sample that selected the factor (*N*=419).

Factors	Frequency	%
Existence of generational renewal in the transhumance livestock raising system.	198	47.26
Existence of a legislative framework that supports/favours transhumance.	166	39.62
Better economic profitability of the transhumant activity than todays'.	152	36.28
Existence of subsidies for the maintenance of transhumance.	131	31.26
Existence of NGOs/institutions that support transhumance.	130	31.03
Better living conditions for shepherds during the spring and autumn displacements with the livestock.	114	27.21
Better conservation of the drove roads (e.g., width respected, water available).	101	24.11
Control and limitations to intermediaries' benefits.	98	23.39
Higher market prices of meat products.	95	22.67
Reduction/facilitation of administrative procedures for the movement of livestock.	91	21.72
Promotion of other compatible uses of the drove road (e.g., sports, recreational and cultural activities.)	91	21.72
Cooperation and organization among transhumants.	82	19.57
Development of touristic initiatives related with the transhumant movement.	60	14.32
Control of livestock sanitary problems that might affect the feasibility of the migration.	55	13.13
Labour availability for shepherding.	52	12.41
Better market availability for other products (non-meat; e.g., wool, leather).	49	11.69
Existence of payments for the ecosystem services that transhumance helps to provide for societal wellbeing.	43	10.26
Increasingly higher market prices of fossil fuels that make mechanic transports prices to rise.	24	5.73

Appendix B

From the past to the present

In the first part of the workshop for future scenario planning, participants individually identified three critical issues that they linked with the present situation of transhumance. The issues raised were clustered, and four or five aspects were selected in every group for further discussion on the changes that had taken place from the past to the present, and the causes of these changes. The last 30 years were proposed as a time reference, but during the workshop some descriptions referred to previous times. Table B.1. summarises the resulting characterisation of the transition from the past to the present in the four groups. CAP = Common Agricultural Policy of the EU. ES = ecosystem services.

Before	Now	Causes of change?
Economic profitability		
• Low production costs (small herds) • Lower costs of life (no family migration) • More regular selling • Local selling • No international competition • Municipal slaughterhouses • Lower sanitary costs • More parts of animal were valuable • High economic value of wool • High CAP subsidies (1980s and 1990s) FAMILY SUBSISTENCE ECONOMY	• Higher production costs • More costs for the migration of the whole family • More intermediates in the selling chain • More dependence on international markets (globalization of the food industry) • Stagnation of meat prices • No municipal slaughterhouses • Different social food preferences • Low price of wool (until 2010) • Reduction of CAP subsidies MARKET ECONOMY	• Monopolies controlling prices • Imported meat at lower prices • Industrialisation of food production, distribution and commercialization • Competition with other land uses (e.g. hunting) • Increased price of rangelands • Sanitary regulations designed for sedentary systems • Economic crisis resulting in a lower willingness to pay for quality meat • Changes in food habits • Little contact between producers and consumers • Loss of social support/consideration for rural livelihoods
Social situation		
• Stronger social links within rural areas and culture identity • Poor social services in rural areas • Livestock owners did not usually herd but hired shepherds that included their livestock in the flock	• Loss of cultural identity and transhumance as a way of exchange and links maintenance • Better social services • Most shepherds are the livestock owners themselves	Cultural identity is not taught in formal education • Rural exodus in 1970s, 1980s and 1990s • General loss of contact with the environment and rural livelihoods • Recently a bucolic vision of rural livelihoods and

Before	Now	Causes of change?
• Shepherd were poorly valued but their job was considered of use • Knowledge was transmitted to youngsters – generational continuity • Transhumance was important as a tradition • Only men did transhumance	• Shepherds and their job are poorly valued by society • Better quality of life for shepherds • Lack of generational renewal and loss of traditional knowledge • Slight trends of urban exodus • Social interest for culture/folklore and environmental aspects of transhumance • Frequent participation of women on the farm	traditions is rising • Low economic profitability in comparison to the harshness of the shepherd's job • Acceleration of changes between generations • Technological improvements • Families do not want to be separated • Increasing predominance of men in the rural population
Drove roads		
• Cleaner and wider • With shelters and refuges • Well known, geographically recognized and respected • Clean and abundant water available • Abundant resting places for livestock • More livestock used them • Underused while there were trains • Conflicts between local farmers and transhumant shepherds for the use of drove roads	• Sometimes impassable, polluted or interrupted • Poorly marked but legally recognized since 1995 • Too narrow in some areas (invaded by croplands) • Scarce and unreliable access to water • Few shelters and refuges • Other uses, e. g., recreational activities and sports • Conflicts between farmers and transhumant shepherds for the use of drove roads although these are legally protected	• Croplaands have invaded drove roads with little use • Regrouping of land in second half of the 20th century • Industrialisation of agrarian production nearby (use of high quantities of agrochemicals) • Positioning of rubbish dumps • Lack of maintenance by the state of common infrastructures • Lack of coordination or knowledge of local realities between and within administrations • Drove Roads Act (1995)
Institutions		
• Less bureaucracy • More direct contact with shepherds • Regulations fitted better everyday reality • Stronger farmers' institutions (e. g., Mesta) • National homogeneous sanitary regulation • Little concern for environmental issues	• More bureaucracy • Regulations are non-existent or set out with little coherence with reality • Incoherence and interferences between institutions at different scales • Unfair distribution of CAP subsidies • Perversion of the essential sense of pastoralism by subsidies • Much decision power is at	• Regulations have been developed vertically (top down) with no/little participation of local stakeholders and far away from local needs • Regulations designed to favour an agro-industry model • Joining of Spain to EU (CAP) • Spanish autonomic model of government • Loss of political weight of the rural world in favour of

Before	Now	Causes of change?
	a regional scale • Agrarian syndicalism is not concerned with transhumants problems • Livestock 'demonization' through media campaigns on sanitary alarms	the urban • General institutional perspective of biodiversity conservation as opposite to or independent of local practices • Spanish policies centred on the tertiary sector
Ecosystems, ecosystem services and other contributions to transhumance wellbeing		
• Environmental values related with transhumance were less visible to society • Better provision of ES (except on the drove roads during the train years) • No conflict among land uses (e.g. hunting, gathering and livestock) • Hunting was common and popular	• Emerging awareness regarding the ES associated with transhumance • No social and/or economic acknowledgement of ES (e. g., labelling and payments for ES) • Trade-offs among ES • Hunting is mostly a luxury activity with priority over livestock • Better animal welfare	• The decrease of transhumance and in general extensive livestock rearing models has had visible consequences on the environment and loss of ES

Appendix C

Illustrations of three of the four future scenarios for transhumance in the CDR

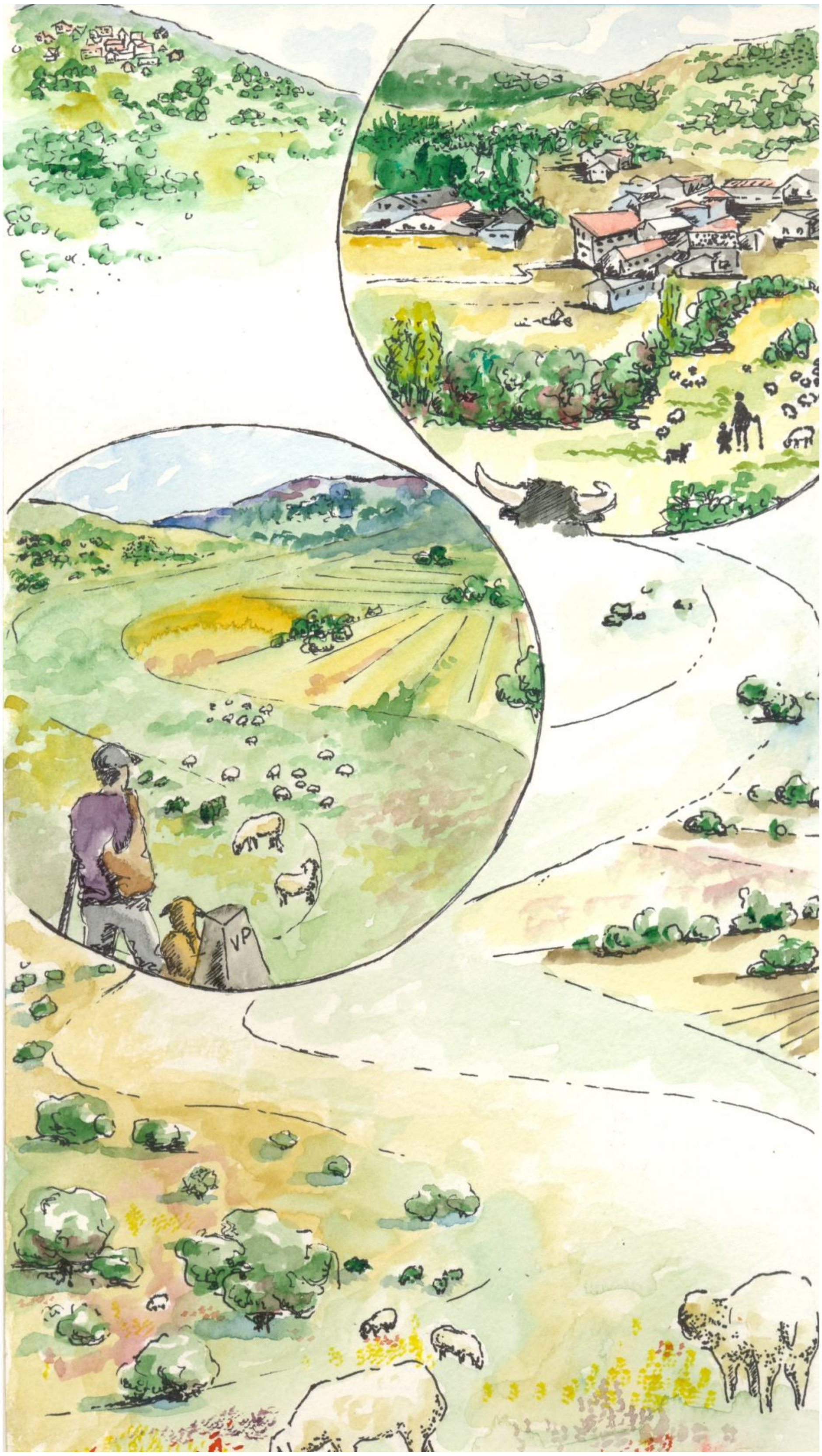

Figure C1. Back-to-future scenario.

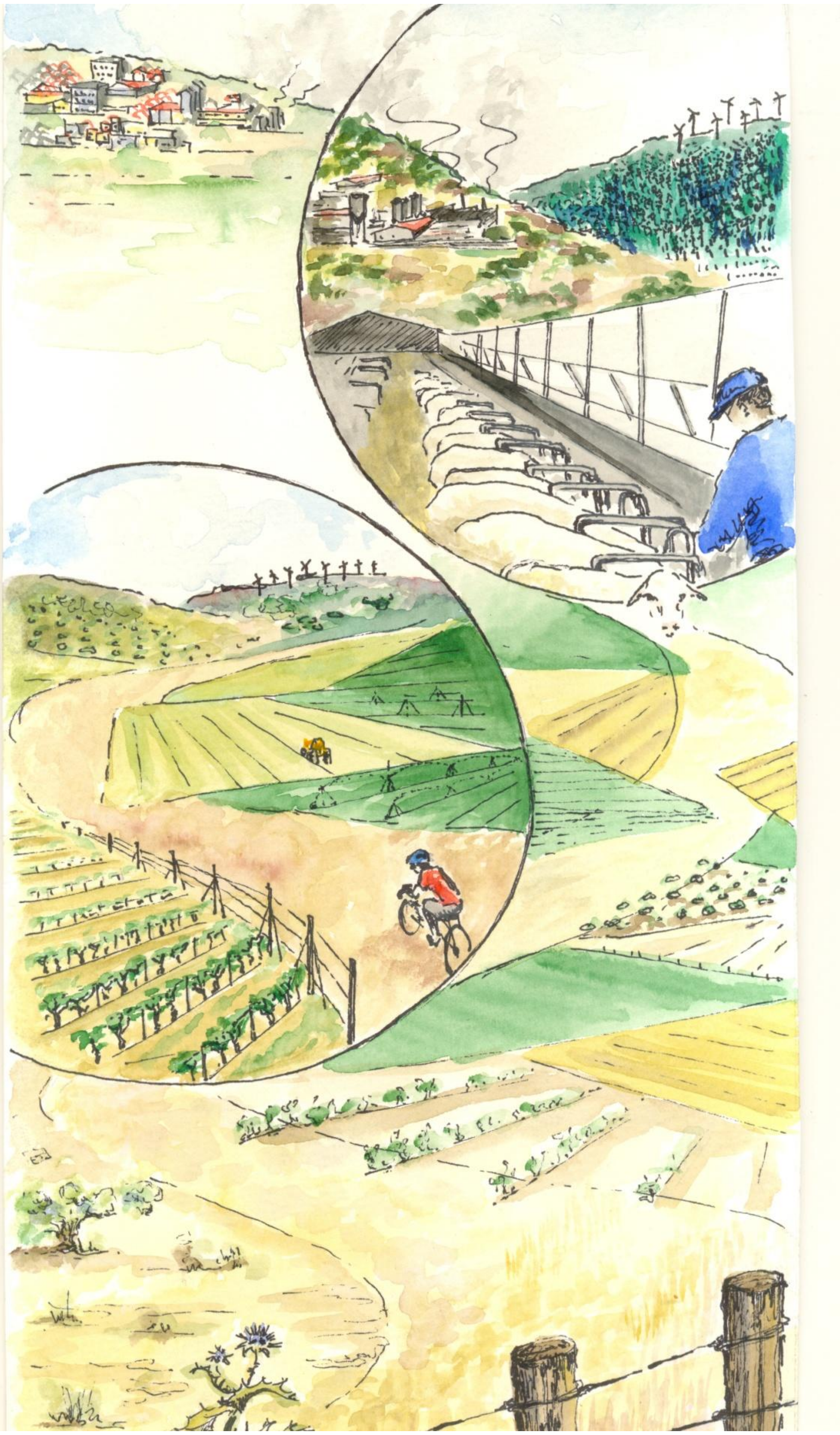

Figure C2. Technology-driven scenario.

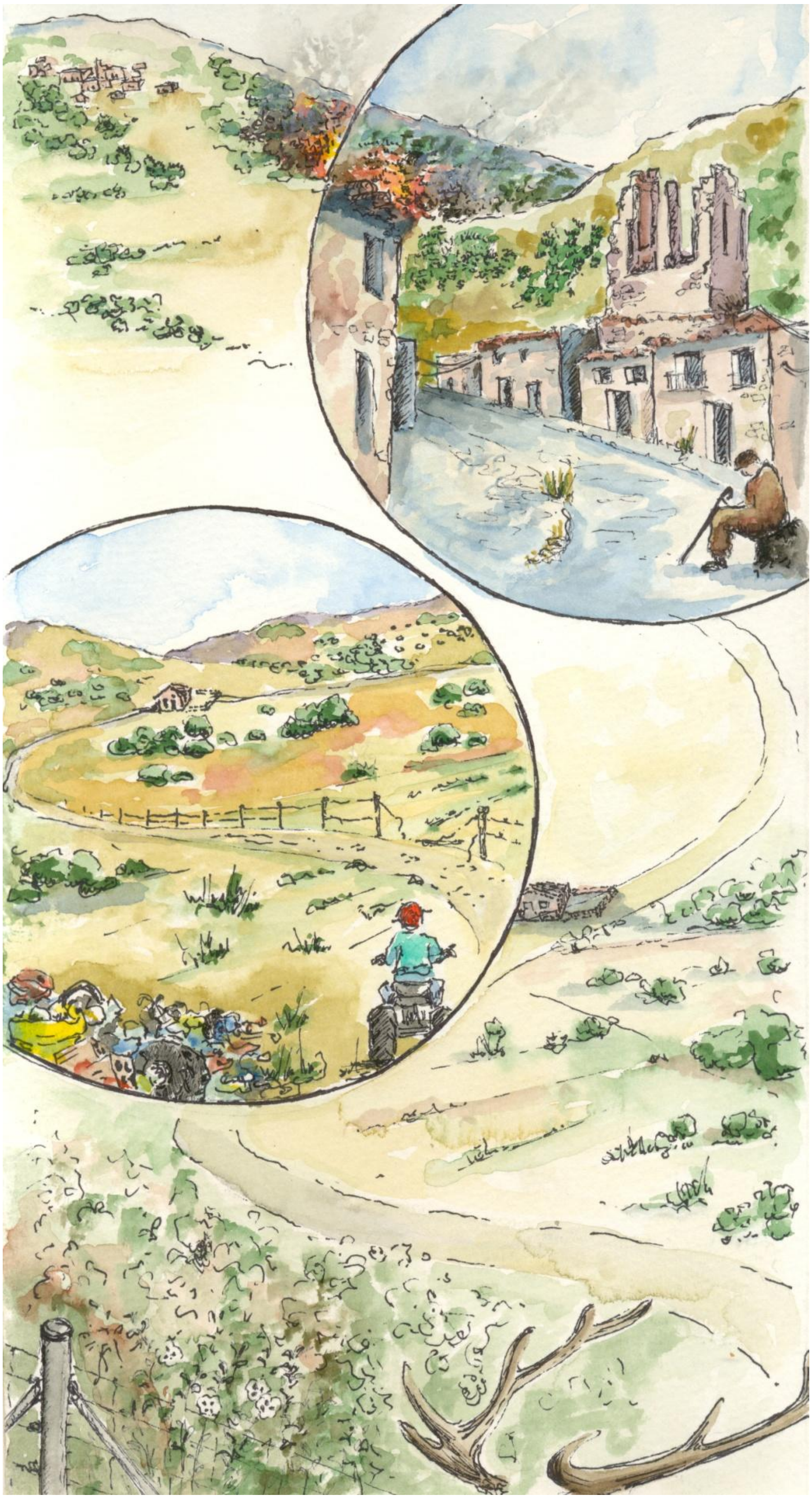

Figure C3. Collapse scenario

Capítulo 5 Discusión

5.1. Ciencias de la Sostenibilidad: reflexiones metodológicas y conceptuales

5.2. Ganadería extensiva y trashumancia en el siglo XXI



En el capítulo anterior se han abordado los objetivos específicos planteados, comenzando por un análisis del panorama de conocimiento existente sobre los servicios generados por los agroecosistemas de la cuenca mediterránea y pasando luego al caso de estudio de la red socio-ecológica de la trashumancia en la Cañada Real Conquense. Llegado este punto abordaremos la discusión general reflexionando en torno a cuestiones metodológicas y conceptuales relativas a la investigación en Ciencias de la Sostenibilidad (5.1) y acerca de la trashumancia en el siglo XXI (5.2.), analizando de forma crítica los resultados obtenidos y proponiendo medidas y acciones concretas, considerando distintas escalas espaciales y temporales así como institucionales, que contribuyan a la sostenibilidad de la red socio-ecológica estudiada.

5.1. Ciencias de la Sostenibilidad: reflexiones metodológicas y conceptuales

El trabajo de investigación cuyo resultado se plasma en la presente memoria de Tesis Doctoral pretende aproximarse a la trashumancia, una práctica agraria tradicional de la cuenca mediterránea, desde una perspectiva socio-ecológica y con las herramientas metodológicas propias de las Ciencias de la Sostenibilidad. Estos marcos conceptual y metodológico han resultado de gran ayuda para abordar los objetivos propuestos.

5.1.1. Definiendo el objeto de estudio: los Sistemas Socio-ecológicos

La conceptualización y delimitación de los sistemas socio-ecológicos, objeto de estudio de las Ciencias de la Sostenibilidad, constituye uno de los mayores retos a los que éstas se enfrentan. En este sentido, el estudio de una práctica agraria desde la perspectiva de los sistemas socio-ecológicos plantea ciertas dificultades. Si bien la trashumancia había sido anteriormente conceptualizada a la luz de la particular interacción entre seres humanos y naturaleza mediante el término de "paisajes culturales trashumantes" (Herzog et al., 2005), la propuesta de conceptualización como "red socio-ecológica de la trashumancia" (capítulo 4.2.) pretende dar un paso más para enfatizar la naturaleza dinámica y multidireccional de los flujos de materia, energía e información que se dan entre los sistemas sociales y los ecosistemas involucrados (Fig. 5.1).

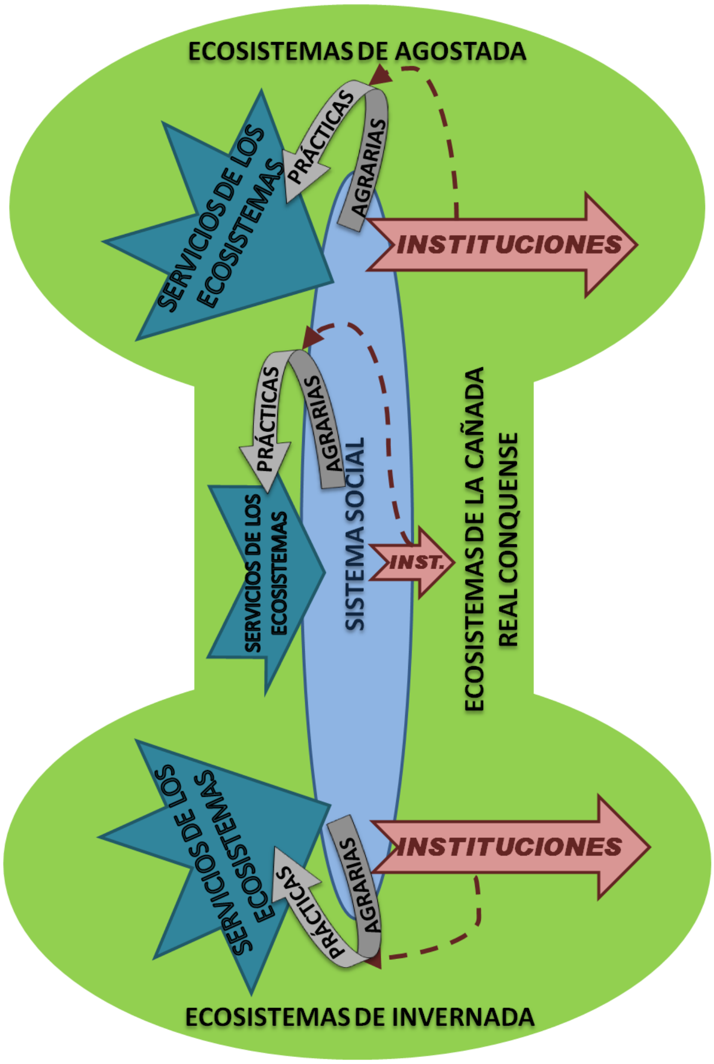

Figura 5.1. Mapa conceptual de la red socio-ecológica de la trashumancia, incluyendo las relaciones entre los ecosistemas, el sistema social, las prácticas agrarias tradicionales, los servicios de los ecosistemas y las instituciones.

Asumir la perspectiva de red resulta útil porque permite poner de manifiesto las interacciones entre los componentes del sistema socio-ecológico y su naturaleza. De esa forma, ha permitido analizar los actores sociales e instituciones involucrados en la red socio-ecológica (capítulos 4.2, 4.3 y 4.4) así como los diversos impulsores de cambio que han afectado y afectan a la práctica (capítulos 4.5, 4.6 y 4.7). Esta aproximación contribuye a des-culpabilizar la presencia humana en los ecosistemas y revalorizar el papel de determinados actores sociales que no sólo no destruyen biodiversidad, sino que contribuyen con sus prácticas al mantenimiento de la misma, al buen funcionamiento de los ecosistemas y al suministro de servicios y, por tanto, a su sostenibilidad.

Tal y como se ha visto, si bien la aproximación a los agroecosistemas, entendidos como sistemas socio-ecológicos requiere de aprendizajes complejos e interdisciplinarios, los resultados del capítulo 4.1 muestran que hasta el momento la mayor parte de las aproximaciones son sectoriales y unidisciplinares.

Otro de los resultados fundamentales del capítulo 4.1 muestra cómo, si bien parece que la creciente comunidad involucrada en las Ciencias de la Sostenibilidad está haciendo un esfuerzo en la última década por escuchar el llamamiento que a principios de siglo se hacía desde la comunidad científica para la ampliación del **rango de escalas espaciales que se abarcan**, desde las dinámicas globales hasta las prácticas agrarias locales (Kates et al., 2001), existen aún sesgos en la distribución y tipología de estudios disponibles.

Concretamente, tal y como se plantea en capítulo 4.2, conviene poner en práctica los planteamientos epistemológicos a través de la **investigación en casos de estudio concretos** no sólo para testar la idoneidad de los constructos teóricos en relación a las realidades locales, sino también, para aprender del camino y explorar nuevos horizontes. Asimismo, **estudios coordinados entre varios proyectos** que permitan la comparación y el contraste a través de múltiples escalas y a lo largo del tiempo, pueden permitir abarcar todo un espectro de variaciones (Liu et al., 2007). Fruto de cada proceso surgen avances conceptuales y metodológicos que pueden servir de inspiración para otras realidades locales, aunque nunca para la extrapolación directa (capítulo 4.7).

5.1.2. Abordando el objeto de estudio: los marcos metodológicos

Tal y como se ha mostrado en la presente memoria, resulta interesante la exploración de un mismo caso de estudio con **perspectivas y metodologías diversas** (capítulos 4.3, 4.4, 4.5, 4.6 y 4.7) que permitan así percibir la complejidad característica de los sistemas socio-ecológicos.

En primer lugar, la aproximación a los objetivos a través de la **multiplicidad y diversidad de escalas** ha resultado útil en dos sentidos: (1) por un lado, en cuanto a las escalas espaciales, desde el análisis de los agroecosistemas de la cuenca mediterránea al de una práctica agraria en un zona concreta (la trashumancia en la Cañada Real Conquense); (2) por otro lado, en el caso de estudio, abordando desde la escala individual mediante por ejemplo entrevistas en profundidad a actores clave (capítulos 4.3, 4.5 y 4.6), hasta una escala más amplia a través de cuestionarios sobre percepción del bienestar de la sociedad o el diseño participativo de escenarios de futuro (capítulo 4.3 y 4.7).

En cuanto a la **aproximación metodológica**, la integración de metodologías cualitativas y cuantitativas ha resultado fundamental a la hora de proceder en la investigación, debido a la complementariedad de la información que aportaba cada una de ellas y, por tanto, para la interpretación y discusión de los resultados desde una perspectiva integradora. Como ecóloga, las herramientas de investigación tomadas de las Ciencias Sociales han resultado especialmente útiles a lo largo de toda la investigación: desde las exploraciones preliminares mediante entrevistas, pasando por la observación participante, el diseño y aplicación de cuestionarios, el desarrollo de talleres y finalmente para el análisis crítico de los resultados con una sólida base en un conocimiento etnográfico del caso de estudio. De hecho, las metodologías aplicadas en esta investigación no sólo han promovido una visión integradora y holista de los procesos socio-ecológicos, sino que además han resultado complementarias ya que cada una de las técnicas usadas tiene diferentes ventajas e inconvenientes como muestra la tabla 5.1.

Tabla 5.1. Ventajas e inconvenientes de los diferentes métodos y herramientas aplicadas en la presente Tesis Doctoral.

MÉTODOS/ HERRAMIENTAS	VENTAJAS	INCONVENIENTES
Revisión bibliográfica	• Monetariamente poco costosa • En determinados ámbitos puede dar un buen conocimiento del tema	• Requiere mucho tiempo • Se plantea el dilema sobre la inclusión de "literatura gris"
Observación participante	• Permite obtener información muy completa de la realidad de estudio • Facilita la comprensión de muchas de las dinámicas complejas de los socio-ecosistemas • Permite percibir detalles que escapan mediante otras metodologías • La empatía que se crea respecto del objeto de observación aumenta el compromiso por la acción y por la divulgación de los resultados	• Requiere de un elevado grado de implicación personal • Requiere mucho tiempo • Puede resultar invasiva de la vida de otras personas • Puede dificultar el "extrañamiento antropológico" (Velasco y Díaz de Rada, 2007) • Existe riesgo de pérdida de objetividad
Entrevistas semi-estructuradas	• No requieren de un excesivo conocimiento previo del objeto de estudio • Permiten obtener buenas panorámicas preliminares • Permiten ahondar en temas concretos • Son útiles para identificar otros informantes de interés • Permiten identificar cuestiones que el investigador/a no tenía pensado abordar y que pueden ser de vital importancia para la investigación	• Su análisis requiere mucho tiempo • Requieren de voluntad de participación por parte del entrevistado • Si el muestreo no está bien planteado pueden inducir a ideas erróneas por representar sólo discursos individuales
Cuestionarios	• Aportan información representativa de poblaciones, incluso grandes • Permiten testar hipótesis de forma cuantitativa • Facilitan la comparación entre casos de estudio	• Requieren mucho tiempo y trabajo previos • Requieren de más de un investigador (es deseable) • Para el análisis estadístico de la información se requieren tamaños muestrales suficientemente grande • Se pueden obtener resultados sesgados si el cuestionario, la toma o el análisis de datos no están bien planteados

MÉTODOS/ HERRAMIENTAS	VENTAJAS	INCONVENIENTES
Grupos focales	• Permiten el diálogo entre diferentes actores sociales y así complementar conocimientos • Permiten confrontar discursos y percepciones y así explorar conflictos y sinergias • La interacción facilita la evocación de información que alguien puede olvidarse mencionar en una entrevista individual • La logística no es muy compleja	• Requieren de una buena facilitación para no obtener resultados sesgados por el condicionamiento mutuo de los participantes (ej. por condescendencia por amistad o contradicción por enemistad) • Requieren de trabajo previo de preparación mediante otras metodologías
Talleres participativos	• Permiten el diálogo entre saberes técnicos y saberes experienciales • Facilitan la creatividad y la construcción colectiva de conocimiento y la reflexión conjunta • Permiten hacer visibles los conflictos de intereses y los *trade offs* • Pueden facilitar la acción colectiva	• Pueden requerir de logística compleja • Pueden requerir de un grupo grande de investigadores, facilitadores y relatores • No resultan eficaces sin una buena facilitación y relatoría • El coste monetario y en términos de tiempo pueden ser elevados • Requieren de gran compromiso y esfuerzo por parte de los participantes • Pueden crear expectativas que luego no se cumplan • Hay personas que pueden sentirse coaccionadas a la hora de expresar sus opiniones, si en el taller hay actores sociales con relaciones de poder desiguales entre sí

Por último, la metodología empleada ha demostrado la importancia del **maridaje entre saberes** locales o tradicionales y el conocimiento científico-técnico, cuya complementariedad resulta esencial tanto para la comprensión de las dinámicas de funcionamiento de los socioecosistemas, como para el planteamiento de propuestas de gestión (ej. Knapp y Fernández-Giménez, 2009 y Huntington, 2010). Según Sevilla Guzmán (2013), la imposibilidad del pensamiento científico para resolver los problemas planteados por la crisis global (es decir, la crisis de civilización) está transformando profundamente el mismo pensamiento científico, aceptando que, tanto la Modernidad de la que surge, como su propia epistemología, necesitan complementarse con otras concepciones del mundo (o parcialidades socioculturales). De hecho, la recientemente creada Plataforma Intergubernamental sobre Biodiversidad y Servicios de los Ecosistemas (IPBES, por sus siglas en inglés) reconoce abiertamente la necesidad de integrar el conocimiento tradicional y el conocimiento científico de tal forma que se aprovechen las posibles sinergias positivas (UNEP, 2012) y esta tesis pretende ser un esfuerzo en este sentido (especialmente los capítulos 4.6 y 4.7).

5.1.2.1. El marco de los servicios de los ecosistemas

El concepto de servicios de los ecosistemas se propone como puente entre los ecosistemas y su biodiversidad y el bienestar humano, con el objeto de hacer visible de forma más evidente la relación de dependencia del segundo respecto de los primeros (Díaz et al., 2006). La vinculación del análisis de los sistemas socio-ecológicos y los servicios de los ecosistemas a través del concepto de "procesos promotores de la sostenibilidad" ("*sustainability-enhancing processes*") mejora el potencial integrador de las Ciencias de la Sostenibilidad (Glaser et al., 2012). En este sentido, se puede considerar que **determinadas prácticas agrarias, como la trashumancia, pueden ser entendidas como procesos promotores de la sostenibilidad**. De esta forma, el estudio de los agroecosistemas y los servicios que éstos contribuyen a generar, puede facilitar la puesta en valor de las prácticas responsables de mantener dichos procesos.

Uno de los retos abordados en la presente Tesis Doctoral consistía en la descripción y exploración de los vínculos entre una práctica agraria, la trashumancia, y el bienestar humano. El marco de los servicios de los ecosistemas ha resultado de gran utilidad para abordar este reto, permitiendo explorar las percepciones socio-culturales sobre la triple **relación entre *ecosistemas-prácticas-bienestar humano***. En este sentido, el marco de servicios de los ecosistemas ha permitido:

- hacer visible la importancia de los servicios de regulación y culturales (más allá de los servicios de abastecimiento), identificando los *trade-offs* y las sinergias existentes entre los diferentes servicios de los ecosistemas, así como los conjuntos (o *bundles*) que tienden a generarse (capítulos 4.3, 4.4 y 4.7);
- explorar las posibles consecuencias en términos de bienestar humano, de diferentes escenarios de manejo y, por lo tanto, incorporar la incertidumbre (capítulos 4.4 y 4.7);

- poner de manifiesto conflictos entre diferentes beneficiarios de los servicios de los ecosistemas (capítulos 4.3 y 4.7);
- facilitar el diálogo de saberes entre actores sociales diferentes (capítulos 4.5 y 4.7)
- explorar los vínculos entre una práctica agraria y la resiliencia del socioecosistema vinculado a ésta (capítulo 4.6);

En el caso de socioecosistemas como los agroecosistemas de la cuenca mediterránea resulta urgente e imprescindible hacer visible la influencia mutua existente entre el subsistema ecológico y el subsistema social a través de determinadas prácticas agrarias tradicionales, de forma que la sostenibilidad de los agroecosistemas depende del equilibrio en esas relaciones. Las instituciones son moldeadoras del comportamiento humano, en tanto en cuanto permiten o prohíben acciones, proveen de estructuras para las interacciones y crean significados comunes para las acciones y medidas (North 1990; Ostrom 1998), que en su conjunto facilitan el funcionamiento conjunto del socioecosistema (Ostrom 2009). Por ello, **la sociedad, con capacidad de decisión y voluntad, tiene la responsabilidad de, a través de las instituciones, promover, incentivar o simplemente no obstaculizar el desarrollo de las formas de manejo que se relacionan con un flujo rico y diverso de servicios**, sin desequilibrar la balanza hacia la maximización del flujo de determinados servicios (habitualmente de abastecimiento) en detrimento de otros (habitualmente de regulación y culturales).

La **valoración de servicios de los ecosistemas** se desarrolla como "una herramienta al servicio de la toma de decisiones, cuyo fin es identificar la elección óptima entre distintas alternativas de gestión para dar salida a un determinado problema" (Gómez-Baggethun, 2010). Tal y como se ha visto en el capítulo 4.1, con el objetivo de facilitar o canalizar el trabajo de conservación de los ecosistemas y sus flujos de servicios, la valoración de servicios de los ecosistemas está creciendo en el ámbito académico y político muy rápidamente. Sin embargo, tanto las intenciones institucionales que subyacen a la valoración de los servicios de los ecosistemas como el uso que se hace de los resultados de las mismas en la toma de decisiones pueden ser muy diversos y en ocasiones diferir significativamente respecto de los objetivos iniciales del marco de servicios de los ecosistemas (i.e., hacer visible frente a la sociedad y a los tomadores de decisiones la importancia de los ecosistemas para mantener el bienestar humano). Este hecho ha inducido a críticas al propio concepto de servicios de los ecosistemas y ha generado un **debate en torno a los métodos de valoración de servicios**.

Los métodos de valoración no son ideológicamente neutrales (Gómez-Baggethun et al. 2010), sino que son construidos culturalmente y, por tanto, actúan en sí mismos como instituciones articuladoras de valor con influencia en la toma de decisiones (Jacobs, 1997; Vatn 2005) (véase capítulo 4.3.). En el capítulo 4.1 se ha mostrado cómo la evaluación de servicios en los agroecosistemas mediterráneos (del mismo modo que han señalado otros autores a otras escalas, Vihervaara et a., 2010 y Seppelt et al., 2011) está sesgada hacia valoraciones monetarias. En tanto en cuanto **los métodos de valoración más utilizados son los monetarios**, los criterios que se consideran en los procesos de toma de decisiones responden a análisis coste-beneficio, cuyo uso fomenta a su vez la demanda de valoraciones económicas por parte de la administración, generando así un ciclo de realimentación positiva perverso (Martín-López et al., 2013) e invisibilizando otras aproximaciones, como las valoraciones multicriterio, que se basan en la concepción de la naturaleza multidimensional del valor (i.e., biofísica, cultural y monetaria) (Gómez-Sal et al., 2007). Asimismo, los métodos de valoración monetaria son ampliamente cuestionados por otros motivos como (1) su "miopía" frente a la complejidad ecológica que rodea a los servicios de los ecosistemas (Naredo, 2003), (2) los sesgos metodológicos, (3) la influencia de la realidad socio-económica -como el Producto Interior Bruto (PIB) del país en el que se realiza el estudio (Oteros-Rozas, 2009)-, o (4) los sesgos relativos a la influencia de cuestiones morales y experiencias individuales previas (Kahneman y Knetsch, 1992; Spash, 2006; Martín-López et al., 2007). Sin embargo, la principal crítica es que la valoración monetaria abre la oportunidad de la mercantilización de la naturaleza (Peterson et al. 2010; Gómez-Baggethun et al. 2010). Asimismo, a raíz de la mayor abundancia de las valoraciones monetarias y de los análisis coste-beneficio, de la buena acogida de estas herramientas en los foros de toma de decisiones y de la consiguiente creación de instrumentos de mercado para la presunta conservación de la naturaleza (en forma por ejemplo de pagos por servicios ambientales, ver más adelante apartado 5.2.2.3), frecuentemente se percibe el concepto de servicios de los ecosistemas como inexorablemente vinculado a la mercantilización de la naturaleza.

Sin embargo, no son pocas las voces que defienden que esas tendencias no necesariamente invalidan el marco de servicios para el cumplimiento de sus objetivos originales. De hecho, recientemente se están desarrollando otras corrientes académicas que enfrentan esta tendencia proponiendo **formas de valoración de los servicios de los ecosistemas diferentes a las monetarias** (principalmente enmarcadas dentro del dominio del valor socio-cultural) y que cumplen el mismo objetivo fundamental de hacer visible los múltiples servicios suministrados por los ecosistemas a la sociedad (Chan et al., 2012). De hecho, en el contexto de los paisajes culturales (como los agroecosistemas de la cuenca mediterránea) que se caracterizan por el especial valor de la interacción cultura-ecosistema, resultada especialmente interesante la aplicación de metodologías de valoración socio-cultural de los servicios de los ecosistemas.

En concreto, la investigación que se presenta en esta memoria pretende contribuir al debate sobre la utilidad del marco de servicios de los ecosistemas y de la valoración socio-cultural de los mismos para la puesta en valor de la naturaleza y la biodiversidad en el caso de las prácticas agrarias tradicionales y en concreto de la trashumancia. En este sentido la valoración socio-cultural de servicios ha mostrado ser una herramienta interesante para:

- Incorporar la participación en la investigación, así como diferentes saberes y formas de conocimiento, por su sencillez metodológica y conceptual (capítulos 4.2, 4.3, 4.4, 4.6 y 4.7).
- Distinguir y valorar numerosos servicios culturales y de regulación sin reflejo en el mercado, cuyo flujo depende del mantenimiento de la práctica de la trashumancia y cuya demanda y disfrute tiene lugar desde la escala local (como en el caso del conocimiento local) hasta la escala más global (como en el caso de la prevención de incendios) (capítulos 4.2, 4.3, 4.4, 4.5 y 4.7).
- Identificar de forma temprana posibles amenazas por la pérdida o la elevada vulnerabilidad de determinados servicios de los ecosistemas, a través de la percepción de los actores sociales locales sobre la tendencia de los mismos y el grado en que los actores sociales dependen de los servicios de los ecosistemas (ej. incendios, capítulo 4.3).
- Explorar diferentes "vehículos de valoración" como la percepción "cognitiva" (capítulo 4.3) y la percepción visual (capítulo 4.4), desde los que se puedan comprender los vínculos, no sólo materiales o de manejo sino también

espirituales o sentimentales, entre la sociedad y la naturaleza. La cultura[15] es aquello que hace al ser humano diferente de muchas otras especies, y es en gran medida el estilo de vida mayoritario en los países del norte global el responsable de la actual crisis de civilización, por lo que la perspectiva socio-cultural puede contribuir a encontrar o crear equilibrios dinámicos sostenibles.

- Explorar y poner de manifiesto la diversidad de percepciones de los distintos actores sociales (capítulos 4.3 y 4.4), identificar sesgos y reflexionar sobre las consecuencias que esas percepciones tienen en las decisiones relativas al manejo de los ecosistemas. Por ejemplo, la diferencia entre las percepciones de las poblaciones rurales y las urbanas muestra una considerable desconexión de estas últimas de los ecosistemas, que se ve reflejada en visiones románticas o bucólicas (estrechamente relacionadas con los usos recreativos) y visiones materialistas (más relacionadas con el abastecimiento de materias primas). De esta forma, el interés de satisfacer la demanda de servicios de una u otra población, o el origen de las políticas de gestión (ej. local, autonómico, estatal o europeo) influye considerablemente en los resultados de los procesos de toma decisiones con vistas a la gestión de los ecosistemas.

- Explorar la escala y las dimensiones del bienestar que se ven satisfechas a través de los servicios de los ecosistemas (capítulo 4.3 y 4.7), lo que puede contribuir a conocer mejor las motivaciones subyacentes a los comportamientos pro-conservación, al abandono rural o, al contrario, al retorno al medio rural y la revitalización de las prácticas agrarias en el contexto de la cuenca mediterránea.

- Evitar las dificultades que se dan en el caso de la valoración monetaria y la biofísica a causa del solapamiento de servicios de los ecosistemas, ya que en la aproximación socio-cultural el doble conteo no supone un problema. Cada servicio puede desglosarse tanto como los beneficiarios consideren (capítulos

[15] "La cultura alude a las tradiciones de pensamiento y conducta aprendidas y socialmente adquiridas en las sociedades humanas" (Harris, 1987). Introducción a la antropología General Alianza Editorial.

4.2, 4.3 y 4.4) y de esta forma, se puede alcanzar mayores niveles de detalle en la exploración de *trade offs* y sinergias que, de otro modo, quedarían ocultos (capítulo 4.7). En el caso de la ganadería este punto ha resultado especialmente interesante, pues se ha podido explorar separadamente por ejemplo el alimento para animales (pastos y forraje) del alimento de origen animal (carne y lácteos).

Si bien la valoración socio-cultural ha demostrado ser una herramienta útil, no se puede olvidar la naturaleza compleja de los socioecosistemas y, por tanto, tal y como se plantea en el capítulo 4.2, se hacen necesarios **marcos metodológicos multidimensionales y plurales** que generen información multimétrica sobre las dimensiones del valor que resultan irreductibles e inconmensurables (Martínez- Alier et al., 1998; Busch et al., 2012; Martín-López et al., 2013). En el caso de los agroecosistemas de la cuenca mediterránea y las prácticas agrarias tradicionales que desde hace milenios los han moldeado, resulta particularmente importante visibilizar no sólo la "multifuncionalidad", sino la "multidimensionalidad" de sus valores, prestando especial atención la dimensión socio-cultural de los mismos. **Las prácticas agrarias tradicionales en la cuenca mediterránea están en claro retroceso desde hace decenios, en gran medida por la escasa valoración socio-cultural de los sistemas socio-ecológicos en los que se desarrollan**, por lo que la llamada a la valoración de los servicios que generan, cobra especial relevancia con vistas a su sostenibilidad.

5.1.2.2. Actores sociales: interdisciplinariedad y participación

Dos de los ejes fundamentales de la investigación en Ciencias de la Sostenibilidad son la vocación interdisciplinaria, cuyo propósito es la exploración de las interacciones complejas que se establecen entre los sistemas naturales y humanos; y la participación, tanto en la generación de conocimiento y comprensión de los sistemas complejos y sus problemáticas como en la generación de propuestas. En el marco metodológico de la presente Tesis Doctoral (capítulo 4.2.), estos dos elementos constituyen los dos ejes transversales de la investigación.

La **participación** de diversos actores sociales en las investigaciones ha sido un reto difícil. Con esta participación se ha buscado el equilibrio y el diálogo entre diferentes saberes, de carácter experiencial local o tradicional, técnico y académico, y ha resultado fundamental tanto para abordar la complejidad, como para poder traducir los resultados de las investigaciones en propuestas de manejo sostenible de los ecosistemas. En la presente investigación, la participación (en especial de los pastores trashumantes, pero también de los habitantes locales de la zona de estudio) se ha realizado durante la fase de identificación, caracterización y valoración de los servicios de los ecosistemas (capítulos 4.3, 4.4 y 4.5), así como durante la última fase de planificación de escenarios de futuro (capítulo 4.7). Sin embargo, a pesar del estrecho contacto y gran participación (especialmente de los ganaderos que se involucraron en todo el proceso de la investigación) el trabajo realizado aún no se ha visto reflejado en la puesta en marcha de muchas de las medidas propuestas. Esto da lugar al cuestionamiento de las formas de plantear la participación en el marco de proyectos de investigación. El compromiso de los actores sociales en el análisis y la toma de decisiones debe ir de la mano de mecanismos vinculantes que articulen la relación entre quienes participan en los procesos de investigación y de toma de decisiones (y, por tanto, generan conocimiento colectivo) y la implementación de las decisiones tomadas. Este compromiso abarca desde los distintos niveles de la administración pública, a las instituciones locales, las personas investigadoras y los actores sociales que habitan el socioecosistema. Asimismo, la conexión adecuada entre procesos diversos de generación del conocimiento debería facilitar el manejo sostenible de los ecosistemas, no mediante dinámicas de arriba hacia abajo sino de abajo hacia arriba.

La **interdisciplinariedad** en la investigación se ha realizado mediante la colaboración con personas y grupos, así como el estudio de investigaciones previas, en Biología, Ciencias Ambientales, Ingeniería Forestal y Agrónoma, Geografía, Antropología, Sociología, Psicología, Ciencias Políticas, Economía e Historia y ha resultado compleja a la vez que enriquecedora. Si bien las llamadas a la inter- y trans-disciplinariedad son abundantes en el seno de la academia, en la práctica, especialmente en España, no existe aún un clima excesivamente favorable para este tipo de aproximaciones.

Por último, los procesos de investigación en el marco de las Ciencias de las Sostenibilidad, desde el diseño hasta el análisis y la discusión de los resultados, pasando por la generación de propuestas de acción para la gestión de los socioecosistemas deben ser el fruto de la **interacción cooperativa entre investigadores/as con perfiles específicos en cada una de las disciplinas, investigadores/as con perfiles formativos de carácter más holístico e integrador y representantes de todos los actores sociales cuya dependencia del socioecosistema estudiado o influencia en éste, sea relevante**. Desde el punto de vista de las disciplinas concretas, los abordajes de la Agroecología y la Ecología Política han resultado de especial interés en el desarrollo de la presente Tesis Doctoral (apartado 5.2.2.4), si bien la investigación no estaba planteada desde dichos marcos. Ambas perspectivas, así como su emergente interacción en la *Agroecología Política* (Calle Collado y Gallar, 2010; González de Molina, 2012) han servido de inspiración tanto para el análisis crítico de los resultados y la generación de propuestas de acción concretas en relación a la trashumancia (especialmente en el capítulo 4.7), como para la apertura de nuevos horizontes de investigación y acción.

5.1.2.3. El marco de la resiliencia

Tal y como se mencionaba en la introducción, las Ciencias de la Sostenibilidad y la teoría de los sistemas socio-ecológicos están inextricablemente ligadas a **la resiliencia**, entendida con múltiples significados: (1) como metáfora relacionada con la sostenibilidad, (2) como una propiedad de los modelos dinámicos o (3) como una variable medible que se puede evaluar en estudios de campo (Carpenter et al., 2001), entre otras. En el presente trabajo el marco de la resiliencia se ha aplicado especialmente **como metáfora y como concepto híbrido** (categoría II según Brand y Jax, 2007), para entender (aprendiendo del pasado) los retos que enfrenta la trashumancia en la actualidad, y cómo pueden influir la incertidumbre y los impulsores de cambio en el futuro (capítulos 4.5, 4.6 y 4.7).

En concreto en el capítulo 4.5, partiendo de la asunción de que parte de la resiliencia de un socioecosistema reside en su capacidad para mantener un flujo de servicios de los ecosistemas (Adger et al., 2005), se ha explorado (1) cómo los servicios generados por los ecosistemas vinculados a la trashumancia contribuyen a la construcción de resiliencia socio-ecológica, y (2) cómo la trashumancia ha enfrentado las perturbaciones a lo largo de su historia socio-ecológica. En particular, en este capítulo se explora la resiliencia de la propia red socio-ecológica de la trashumancia en el pasado, para así analizar el presente de la actividad frente a los impulsores de cambio identificados. En el capítulo 4.6 se hace un zoom al conocimiento ecológico tradicional en concreto para explorar cómo las prácticas, conocimientos y creencias vinculadas a la trashumancia pueden contribuir a la adaptación al cambio global. Tal y como se muestra, la trashumancia, no sólo es en sí misma una estrategia adaptativa basada en la movilidad, sino que por las prácticas, conocimientos y creencias que tiene asociadas, engloba interesantes valores para la adaptación al cambio global. Sin embargo, a menudo caemos en una visión romántica y nostálgica de paisajes culturales como los agroecosistemas mediterráneos, cuando éstos son fruto, en ocasiones, de intervenciones y usos insostenibles o de injusticias sociales (Bieling y Plieninger, 2012) y en cualquier caso de procesos en continuo cambio. En este sentido, la aproximación desde la resiliencia contribuye a percibir los sistemas socio-ecológicos como "seres vivos" en continuo cambio y comprender sus características, funcionamiento y estados, no como positivos o negativos sino mostrando los *trade-offs* entre distintos valores. La metáfora de la resiliencia contribuye, de esta forma, a reflexionar sobre las políticas o los incentivos relativos a las prácticas agrarias tradicionales y cómo aprovechar los conocimientos y prácticas ancestrales (a través de los que las sociedades han convivido durante milenios sin sobrepasar los límites biofísicos de los ecosistemas), sin aferrarse, en cambio, a la "foto fija" de un pasado idealizado, y mantenerse ajenos a los cambios inherentes a la vida de los sistemas complejos adaptativos.

Por último, las perspectivas adquiridas en los capítulos 4.5 y 4.6, permitieron articular los escenarios de futuro que se exploraron de manera participativa en el capítulo 4.7 y en los que se reflexiona también acerca de la vulnerabilidad de la actividad y de la red socio-ecológica bajo distintas opciones. En el capítulo 5.2 se discutirá sobre los aprendizajes concretos que la aplicación de la metáfora de la resiliencia ha arrojado en relación al caso de estudio.

5.2. Ganadería extensiva y trashumancia en el siglo XXI

5.2.1. Luces y sombras: ganadería extensiva, trashumancia, servicios de los ecosistemas y resiliencia socio-ecológica

Los agroecosistemas son, por un lado, proveedores de servicios de los ecosistemas y, por otro, consumidores de estos o incluso generadores de deservicios (Zhang et al., 2007;

Power, 2010). Asimismo, entorno a las prácticas agrarias y en relación a otros usos de suelos existen conflictos y *trade-offs.* Tal y como se ha visto en la presente Tesis Doctoral, en torno a la ganadería extensiva emergen "luces" pero también "sombras" que abordaremos en los siguientes apartados.

5.2.1.1. Las "luces"

La ganadería extensiva, y en concreto la trashumante, han sido reconocidas, tal y como se mostraba en la introducción (capítulo 1.3) por su valor ambiental, para el mantenimiento de la biodiversidad (Hatfield et al., 2006) y como herramienta clave para la sostenibilidad (ej. Blondel, 2006; Mortimore et al., 2009; Sayre et al., 2012). En la cuenca mediterránea y en concreto en España, se ha subrayado su estrecha relación con los Sistemas Agrarios de Alto Valor Natural y la red de hábitats de importancia europea (Natura 2000) (Baldock et al., 1993; Beaufoy et al., 1994; Opperman et al., 2012), así como su relación con el suministro de servicios de los ecosistemas (González et al., 2012). En la literatura sobre **servicios de los ecosistemas** existen hasta el momento tres aproximaciones para abordar la ganadería extensiva:

- *como un servicio* de abastecimiento relacionado con la producción de alimentos (ej. Evaluación de los Ecosistemas del Milenio)
- *como usuaria de servicios* (o afectada por los des-servicios[16]) de los ecosistemas (ej. O'Farrell et al., 2007; Boone et al., 2011),
- *como co-productora de servicios*, es decir, como actividad que favorece el suministro de servicios, según lo percibe la población (ej. Lamarque et al., 2011; Heikkinen et al., 2012).

Esta última aproximación es la más similar a la aplicada en la presente Tesis Doctoral. Sin embargo, el plantear la práctica ganadera no sólo como forma de vida y de producción, sino como "escultora" de ecosistemas, ha permitido explorar los vínculos entre la trashumancia y el bienestar humano desde varios ángulos. Si bien esta diversidad de concepciones de la ganadería en el marco de los servicios de los ecosistemas es

[16] Los des-servicios se han definido como los efectos negativos de los ecosistemas para los seres humanos (Swinton et al., 2007) o como los cambios adversos en los procesos ecológicos que conllevan la pérdida de servicios de los ecosistemas (Dominati et al. 2010).

interesante, conviene tener presente que también puede ser fuente de confusión a la hora de transmitir mensajes desde la academia con vistas tanto a futuras investigaciones, como al desarrollo e implementación de políticas. Por tanto, se hace necesario **explicitar detalladamente en cada caso la aproximación que se utiliza.**

Con el objetivo de contribuir a la puesta en valor de la ganadería extensiva y en concreto de la trashumancia a través de la identificación y valoración de los servicios de los ecosistemas vinculados a estas prácticas, así como su importancia para el bienestar humano, se han identificado un total de 34 servicios de los ecosistemas (capítulo 4.3, 4.4 y 4.5). Según se ha mostrado en el capítulo 4.3, se ha encontrado una correlación positiva entre el porcentaje de los encuestados que consideraba que un servicio podría perderse o verse degradado si desapareciera la trashumancia, y el porcentaje de encuestados que consideraban ese servicio como importante para el bienestar humano. En este mismo trabajo se ponía de manifiesto como el 60% de los servicios percibidos como importantes para el bienestar humano estaban relacionados con la conservación de la trashumancia. Por tanto, **la trashumancia se percibe** en la zona de estudio, **como un elemento importante para el suministro de servicios de los ecosistemas y como una práctica clave para el bienestar de los individuos y la sociedad**.

Asimismo, especialmente en los capítulos 4.5 y 4.6, se ha analizado la trashumancia como estrategia adaptativa basada en la movilidad, con el objetivo de mostrar que se trata de una práctica clave para la adaptación al cambio global (Berkes y Jolly, 2001, capítulos 4.5 y 4.6). **La trashumancia encierra un enorme potencial para la adaptación al cambio global y como modelo de red socio-ecológica sostenible y resiliente**. Tanto a través de la conservación del conocimiento ecológico tradicional vinculado a la trashumancia (mediante su uso y su trasmisión intergeneracional), como a través de las propias prácticas inherentes a la actividad (capítulo 4.6) y los servicios que ésta contribuye a generar (capítulo 4.5). A lo largo de su historia socio-ecológica, la trashumancia ha sobrevivido en España a diversas perturbaciones, adaptándose, integrando nuevos conocimientos, tecnologías y marcos institucionales; pero manteniendo esencialmente su razón de ser y su funcionalidad. Es por esto que ha resultado un objeto de estudio interesante para ejemplificar algunos planteamientos de la teoría de la resiliencia de los sistemas socio-ecológicos.

5.2.1.2. Las "sombras"

La ganadería, incluyendo la extensiva, es criticada especialmente en dos sentidos: en primer lugar por su incompatibilidad o contradicción (en determinados casos) con la conservación (ej. Thompson 1993; Newmark et al. 1994; Buller 2008; Heikkinen et al. 2012) y, en segundo lugar, como culpable de la emisión de gases de efecto invernadero y, por tanto, uno de los motores del cambio climático.

En relación a la **incompatibilidad con la conservación**, en el caso de estudio abordado en la presente Tesis Doctoral dicho conflicto no ha sido señalado como especialmente preocupante, si bien es cierto que los ganaderos de la zona de agostada revelaron que tan sólo percibían perjuicios (fundamentalmente limitaciones de usos como la extracción de leña) y poco o ningún beneficio (como la instalación de infraestructuras para el ganado) a raíz de las declaraciones de los Parques Naturales del Alto Tajo y de la Serranía de Cuenca (Sanosa, 2011). En algunas zonas de la península sí se percibe conflicto entre la ganadería y la conservación (Echagaray, 2004), aunque las relaciones de influencia mutua entre poblaciones de mamíferos salvajes y domésticos son complejas (Mangas y Rodríguez-Estival, 2010) como es el caso de la cabra montesa en el Sistema Central (Ferreras Chasco y Redondo Garcia, 2005) y el del lobo en la cornisa cantábrica y en los Pirineos (Lampreave et al., 2011). En otras en cambio, se ha demostrado la estrecha relación entre la conservación de aves carroñeras (Olea y Mateo-Tomás, 2009) u otras especies emblemáticas (Garzón-Heydt, 2005) con la presencia de ganado (Huntsinger et al., 2012).

En la zona de estudio, en cambio, **los conflictos más patentes se dan con la caza mayor** (en las zonas de agostada e invernada) **y con la agricultura** (en la zona atravesada por la cañada). En el caso de la primera, el crecimiento de las poblaciones de ungulados ha sido muy rápido en los últimos años (especialmente en la zona de agostada donde gran parte del área de pasto se integra en una Reserva Nacional de Caza), por lo que existe competencia de éstos con el ganado por los recursos alimenticios, además de constituir vectores para ciertas enfermedades. En el caso de la rivalidad entre ganaderos y agricultores por el uso de la tierra, se trata de una disputa histórica (Bernal, 1994) sobre todo en las vías pecuarias al paso del ganado. En este último caso, si bien da la impresión de que se trata de un conflicto insalvable, en la realidad se trata a menudo de un equilibrio en el reparto de los usos del espacio público. Por un lado, los agricultores tienden a explotar parte (o en ocasiones casi toda) la vía pecuaria para cultivo, labrando y sembrando terrenos cuyo uso prioritario es el pecuario, bien argumentando que pasan pocos rebaños y por tanto es "terreno baldío" o, en la mayor parte de los casos, creyendo (incluso con documentos catastrales en mano) que gozan del derecho de uso de esas superficies. El deslinde y amojonamiento de las vías pecuarias según la Ley de Vías Pecuarias (3/1995) contribuye en este sentido de manera clave a la resolución de muchas situaciones que en el pasado solían dejar indefenso al pastor frente al agricultor y que solían saldarse con una propina para el último (o el correspondiente guarda de la finca). Desgraciadamente en muchísimos casos los mojones son eliminados o, a pesar de seguir en su lugar, son abiertamente ignorados por los agricultores.

Asimismo, el uso de agroquímicos de manera incluso muy intensiva en algunas zonas, supone hoy en día un problema para los ganados trashumantes por el constante envenenamiento de animales (ovejas, vacas, perros o caballos) a causa de la contaminación de la vía pecuaria. Por otro lado, en este equilibrio, los cultivos adyacentes o superpuestos a la cañada garantizan, especialmente en las trashumancias de verano en años secos, el abastecimiento de alimentos para los rebaños durante muchas jornadas, por lo que existe un cierto "beneficio", más o menos tácito, de la invasión de la vía pecuaria. En ocasiones se dan incluso acuerdos entre ganaderos y agricultores para que los primeros, durante "la vereda" (viaje trashumante), detengan sus rebaños durante unos días en los campos de cultivo con el objetivo de estercolarlos. En algunas de las zonas de invernada de los ganados trashumantes, como en el caso de la Comunidad Valenciana, tradicionalmente algunos de los rebaños pastaban en las huertas de naranjas o hacían uso de los restos de las cosechas de huertas, contribuyendo a la vez a su abonado. Con la industrialización de la agricultura y el incremento en el uso de agroquímicos, este acoplamiento se ha visto restringido y el cierre de ciclos interrumpido.

Respecto a la **relación entre la ganadería y el cambio climático**, el sector ganadero en su conjunto es responsable de la emisión del 37% del metano antrópico (que proviene en su mayor parte del proceso de fermentación ocurrido en la digestión entérica de los rumiantes), el 65% del óxido nitroso antrópico (que en su mayor parte proveniente del estiércol) y el 64% de las emisiones de amonio antrópico (que contribuyen significativamente a la lluvia ácida y a la acidificación de los ecosistemas) (Steinfeld, et al., 2009). A nivel mundial, sin embargo, los pastizales permanentes mantenidos por la ganadería extensiva cubren el 26% de la superficie terrestre del planeta (FAO, 2013) y contribuyen de manera significativa al almacenamiento de carbono en suelos (Conant, 2010). Dada la extensa superficie que ocupan, una gestión adecuada de estos pastizales, mejorando su biodiversidad y productividad a través del manejo ganadero, tiene un considerable potencial de mitigación del cambio climático (Bustamante et al., 2009). Las prácticas que contribuyen al secuestro de carbono en pastizales, aumentan también la resiliencia frente a la variabilidad climática y pueden, por tanto, mejorar la adaptación a largo plazo al cambio climático.

Según la misma Organización para la Alimentación y la Agricultura (FAO) el desarrollo de políticas que fomenten prácticas de manejo de los pastizales con vistas al secuestro de carbono enfrenta, sin embargo, diversos retos; fundamentalmente hacer frente a posibles pérdidas de carbono secuestrado (en caso de sobrepastoreo) y lograr la implicación de los ganaderos y los pequeños propietarios (Conant, 2010). El pastoralismo aprovecha además rastrojeras y residuos agrícolas, cerrando ciclos y transformando residuos y producciones marginales en energía, productos alimentarios y abonos, ahorrando por tanto en insumos que de otra forma tendrían impactos en el cambio climático (Worldwatch Institute, 2004).

5.2.2. Retos de la ganadería extensiva y la trashumancia

5.2.2.1. Globalización y especulación agroalimentaria

Según el Informe sobre la inseguridad alimentaria de la Organización para la Agricultura y la Alimentación de Naciones Unidas de 2011 (FAO, 2011) en torno al 50 % de la población mundial trabaja y vive de actividades productivas relacionadas con la agricultura, la ganadería, la pesca o la silvicultura. En los países en vías de desarrollo el sector agrario ocupa entre un 40 y un 60% de la población activa, representando alrededor del 55% del PIB y en algunos casos hasta el 70% del volumen de exportaciones. El 75% de quienes padecen hambre, tiene como principal fuente de ingresos y vida, una explotación agrícola, ganadera o son pescadores.

En el último decenio, el número de personas que pasan hambre o sufren desnutrición continúa aumentando, hasta alcanzar entre 2010 y 2012 los 870 millones de personas (FAO, 2012), mientras en Europa el abastecimiento de productos agrícolas y ganaderos aumentó entre 1950 y 1990 (Harrison et al., 2010). Las previsiones, en concreto para la producción mundial de carne, hablan de un incremento en la producción de más del doble, pasando de 229 millones de toneladas en 1999/2001 a 465 millones de toneladas en 2050 (Steinfeld et al., 2009; Kearney, 2010). El **incremento en la demanda de alimentos** se debe principalmente a la que Popkins (2006) ha llamado "transición nutricional", caracterizada por el paso acelerado de situaciones de desnutrición ampliamente extendidas a dietas más ricas y variadas y, con frecuencia, también a la hipernutrición, con un particular **incremento del consumo de carne**, especialmente en los países en rápido crecimiento como China (Kearney, 2010).

Esta transición, que en los países desarrollados se llevó a cabo a lo largo de siglos, está produciéndose en el lapso de una sola generación en los países en desarrollo con tasas de crecimiento económico elevadas debido fundamentalmente a (1) la industrialización de la ganadería y (2) la transformación de extensas superficies en áreas de pastoreo extensivo de bajo rendimiento y con escasa sostenibilidad ecológica en el medio plazo (como es el caso del contexto amazónico) o en cultivos de materias primas para piensos compuestos (fundamentalmente soja).

En España, Rodríguez Zúñiga et al. (1980) manifestaban cómo "la entrada masiva de la agricultura en los circuitos comerciales, la tecnificación de las explotaciones, la expulsión de la fuerza trabajo excedentaria o el proceso de monetización de la economía agraria son fenómenos derivados y al mismo tiempo condicionantes del proceso de crecimiento industrial de un país y de la consolidación de un modelo de producción capitalista", cuyas consecuencias se vislumbran a lo largo de la presente Tesis Doctoral. Además del anteriormente mencionado incremento en la demanda de carne, este proceso de industrialización de la agricultura, tanto en España como en otros países, se ha visto acompañado por un crecimiento de la renta que ha influido en **los tipos y calidades de los bienes demandados**.

Por ejemplo, los gustos gastronómicos y el estilo de vida mayoritario en España actualmente son poco compatibles con el tiempo y cuidados que requiere la elaboración de algunas partes de animales como el cordero, lo que redunda en un mayor consumo de "carne rápida" como los filetes y muy escasa demanda de partes que requieren cocciones lentas (ej. caldereta de cordero) (capítulo 4.7). El mantenimiento de estas tendencias en los próximos años no resulta deseable, sino que las necesidades de la población actual y las generaciones futuras requieren de una transformación del modelo agrario productivista e intensivo (Foley et al., 2011) y el modelo de consumo y estilo de vida para favorecer la seguridad alimentaria y la sostenibilidad ambiental.

Por otro lado, la entrada de los alimentos en los mercados financieros ha tenido un tremendo impacto en la producción alimentaria mundial y en los sistemas de distribución, que derivó en la gran crisis alimentaria de 2007 y 2008 (Whal, 2009) y que aún tiene profundas consecuencias en los agroecosistemas y los productores (Bello, 2012). De hecho, en la actualidad los precios de los alimentos no son resultado de la oferta y la demanda, sino de mecanismos de **especulación financiera** en mercados de futuros (de Schutter, 2010).

Frente a este contexto global existen, provenientes de la academia y los movimientos sociales, algunas alternativas que se abordarán en el apartado 5.2.2.4.

5.2.2.2. La Política Agrícola Común de la UE

Hasta los años 50-60 la agricultura europea era fundamentalmente una agricultura basada en formas tradicionales de producción, con escasa reinversión y con dos orientaciones fundamentales: el autoconsumo y el pequeño mercado. Durante la posguerra, en el año 1957, se firmaron los Tratados de Roma. Dentro del Tratado por el que se crea la Comunidad Económica Europea, en el artículo 39, nace la Política Agrícola Común (PAC). Esta política surge en un momento en que Europa era deficitaria en la mayoría de los productos alimenticios, y sus mecanismos se configuraron para resolver esa situación. En este contexto, sus objetivos iniciales eran: (1) incrementar la productividad, (2) garantizar un nivel de vida equitativo a la población agrícola, (3) estabilizar los mercados, (4) garantizar la seguridad de los abastecimientos y (5) asegurar al consumidor suministro de alimento a precios razonables. Desde su entrada en vigor en 1962, la PAC ha sido objeto de cuatro grandes transformaciones y reformas [17] con el objetivo de subsanar los diversos problemas a los que se enfrentaba y re-adaptarla sucesivamente a las nuevas coyunturas socio-políticas intracomunitarias e internacionales.

Actualmente, España es el segundo país, después de Francia, en la recepción de ayudas de la PAC. Un 19% de este presupuesto español correspondió en 2010 a las medidas agroambientales y otros programas para la instrumentalización de los fondos destinados a desarrollo rural, a los que se acogen una de cada diez explotaciones (FEGA,

[17] Estas reformas han sido: en 1988 con la Línea Directriz Agraria, en 1992 con la Reforma de MacSharry, en 1999 con la Agenda 2000, y en 2003 y 2005 para los pilares 1 y 2 respectivamente.

2010). Desafortunadamente, el éxito de la PAC en el contexto español, considerando los objetivos previamente explicitados, es cuestionable por diversas razones. Entre 1962 y 2009 el número de explotaciones agrarias descendió en España en un 67%, mientras su tamaño medio se duplicaba (INE, 1962 y 2009). La proporción de población activa agraria respecto al total ha descendido desde la entrada de España en la Unión Europea, del 13% en 1987 al 4% en 2008 (INE, 2009). De forma similar, el porcentaje de PIB relativo al sector agrario se ha reducido del 6% en 1987 al 2% en 2008 (INE, 2009).

En el caso de la ganadería, la PAC dispone de diversos mecanismos de apoyo (Nori y Gemini, 2011) que, en algunos casos como el del Valle del Ebro (O'Flanagan et al., 2011) o en otras zonas de Europa (Kerven y Behnke, 2011), han resultado exitosos para el mantenimiento de la trashumancia. Sin embargo, por lo general, la PAC ha facilitado o provocado el aumento del número de cabezas de ganado y la intensificación de la producción, especialmente la estabulación y la sedentarización en el caso de las explotaciones trashumantes (capítulo 4.7; Garzón-Heydt, 2005; Herzog et al., 2005). Asimismo, y de manera colateral, se ha fomentado el incremento en la demanda de piensos y otros insumos, teniendo importantes consecuencias ambientales, socio-culturales y económicas negativas en terceros países, especialmente en algunos países del Sur global (Fritz, 2012).

En este momento, se debate en el Parlamento Europeo acerca de una **nueva reforma de la PAC** para el periodo 2014-2020, lo que señala el probable comienzo de una nueva etapa agraria en la Unión Europea y, por tanto, en España. Por un lado, supone un incremento considerable en la incertidumbre que enfrentan las prácticas agrarias tradicionales mediterráneas y, por otro lado, podría constituir una **oportunidad para el apoyo de formas agrarias tradicionales responsables de mantener flujos ricos y diversos de los servicios de los ecosistemas** (la trashumancia entre ellas). La propia Comisión Europea menciona por primera vez la posibilidad de "*remunerar a los agricultores activos por los servicios colectivos que prestan a la sociedad*" (CE, 2010). Desde la academia hace tiempo que se alzan voces en esta misma dirección. En este sentido, por un lado, se reclama que las ayudas deberían dirigirse al aumento de la rentabilidad económica de las explotaciones agrarias, tanto a través de la apuesta por la calidad de los productos y la agricultura ecológica, como por la valoración social de otros servicios de los ecosistemas diferentes de los de abastecimiento (ej. Gómez-Sal, 2007; capítulo 1). Por otro lado, se han observado conexiones entre la aplicación de la PAC (y la transformación de prácticas agrícolas a la que ésta contribuye) y la degradación de los agroecosistemas y los servicios que éstos generan (Lorent et al., 2009 ; Marini et al., 2010; Osterburg et al., 2010).

En este contexto político, se hace especialmente interesante y urgente la generación de conocimiento científico en torno a los servicios generados por los agroecosistemas mediterráneos. Sin embargo, y tal y como se ha señalado en el capítulo 4.1, actualmente existen algunas asimetrías en el conocimiento científico tanto en los tipos de servicios valorados, como de los métodos de valoración empleados, que convendría subsanar para facilitar la incorporación de los servicios de los ecosistemas en el proceso de debate de la nueva reforma de la PAC.

El mismo Parlamento Europeo reconocía que “el mercado ha fracasado en el reconocimiento de los agricultores y ganaderos por su función en la conservación ambiental y la generación de bienes públicos” y hacía un especial llamamiento para el suministro de “incentivos económicos idóneos que optimicen la generación de servicios de los ecosistemas” (EP, 2010). La Comisión Europea (2010) ha identificado tres **grandes retos para la nueva PAC**: (1) el medio ambiente y el cambio climático, (2) el mantenimiento de áreas rurales viables y (3) la seguridad alimentaria.

Abordar estos retos en la actualidad implica considerar otros aspectos claves como: (1) la ampliación de la UE a 27 estados con un sector agrario muy amplio y basado en pequeñas explotaciones tradicionales; (2) la crisis económica y la resistencia de los estados aportadores netos (Alemania y Francia, principalmente) a seguir cediendo fondos; (3) la ralentización de las negociaciones en el seno de la Organización Mundial del Comercio y (4) una conciencia emergente desde la ciudadanía sobre las implicaciones ambientales, sociales y sanitarias de la alimentación (López García, 2012).

Consideramos que los resultados obtenidos en la presente Tesis Doctoral pueden servir de orientación para el desarrollo de determinadas **propuestas** en relación a la actual reforma de la PAC, que podrían sintetizarse en:

- El apoyo específico a los modelos de producción extensiva, las actividades agrarias tradicionales multifuncionales y las prácticas agroecológicas que demuestran ser las responsables de un flujo rico y diverso de servicios de los ecosistemas (capítulo 4.1). La actual coyuntura abre una ventana de oportunidad para una posible transición de una política de subsidios a una política basada en la eficaz generación de servicios de los ecosistemas (Plieninger et al., 2012).

- La revisión y el fortalecimiento de las ayudas específicas a la trashumancia por su importante papel en relación con (1) la generación de servicios de los ecosistemas (Rescia et al., 2008; González et al., 2012), siendo considerados algunos de ellos como servicios determinantes del bienestar de la sociedad (capítulos 4.3 y 4.7) y con (2) el mantenimiento de la resiliencia y capacidad adaptativa frente al cambio global (capítulos 4.5 y 4.6).

- El fomento de las razas ganaderas autóctonas ya que la agrobiodiversidad resulta clave para el buen funcionamiento de los ecosistemas, la generación de resiliencia ecológica y el suministro de servicios (Altieri y Koohafkan, 2004; Garzón Heydt, 2004; Jackson et al., 2007; EME, 2011; Jackson et al., 2012).

- La redirección de las subvenciones hacia pequeños productores para re-balancear el actual reparto desigual de las ayudas. Actualmente, las mayores explotaciones y las empresas procesadoras son las principales beneficiarias de los pagos [18], mientras que las pequeñas explotaciones tienden a desaparecer en parte por falta de rentabilidad económica (capítulo 4.7).

- La revisión de las políticas para facilitar la incorporación de jóvenes a la ganadería ya que no están siendo suficientemente eficaces. Muchos de los entrevistados, de edad comprendida entre los 20 y los 40 años han manifestado serias dificultades para hacer frente a la inversión inicial requerida para satisfacer las normativas vigentes (por ejemplo relativas a las infraestructuras necesarias en toda explotación agropecuaria), así como dudas frente a la asunción del riesgo de inversión en el actual contexto de escasa rentabilidad económica y gran incertidumbre (capítulos 4.5 y 4.7).

- El fomento de la incorporación de la mujer al empleo agrario y el mejor reconocimiento de su papel en las actividades agrarias resulta fundamental

[18] Según datos de la OCDE en 2009 el 74% del apoyo total de la PAC fue a parar al 25% de los beneficiarios compuesto por las mayores explotaciones de la UE, mientras que el 25% compuesto por las explotaciones más pequeñas percibía solo el 3% (Moreddu, 2011).

para la sostenibilidad social de la trashumancia y para la reversión de la severa masculinización que sufre el medio rural en España[19]. Si las mujeres a menudo son responsables de los trabajos de cuidado de la familia, además de las cargas de trabajo fuera de casa, en el caso de las familias ganaderas, esta carga de trabajo puede llegar no sólo doblarse, sino incluso triplicarse en el caso de aquellas que, además de participar en la explotación, tienen su propio empleo (García Roces y Soler Montiel, 2010). Esta perspectiva desincentiva, especialmente entre las jóvenes, tanto la incorporación a la actividad agraria, como el apoyo a los jóvenes que podrían tomar el relevo generacional, lo cual supone una seria amenaza para el relevo generacional. Por otro lado, en el caso de los y las trashumantes la migración dificulta aún más tanto el desarrollo profesional de las mujeres, como el trabajo no remunerado en el hogar, debido a que la doble logística inherente a la forma de vida nómada recae por completo sobre las mujeres. Con vistas al mantenimiento de las prácticas agrarias tradicionales, resulta imprescindible incorporar el enfoque de género por dos razones: (1) por el hecho que las percepciones, roles, conocimientos, necesidades e intereses que tienen hombres y mujeres respecto al manejo de los servicios de los ecosistemas son distintos y deben ser reconocidos para enriquecer y orientar los objetivos, estrategias y actividades de los proyectos (Martín-López et al., 2012) y (2) porque las iniciativas de investigación, conservación y desarrollo no son neutras e impactan de forma diferenciada en hombres y en mujeres (Papuccio de Vidal, 2007).

- La mejora de los mecanismos de participación a nivel europeo para hacer frente a la infra-representación de los ganaderos extensivos y trashumantes en los foros de toma de decisiones, tal como reclama la Iniciativa Mundial por un Pastoralismo Sostenible (Rodríguez, 2008). La necesidad de una mayor atención por parte de los foros internacionales hacia los ganaderos extensivos

[19] Según la FAO, la proporción de mujeres económicamente activas dedicadas a la agricultura en España ha descendido del 18,2% en 1980, al 8,2% en 1995 y al 3,9% en 2010. De la población económicamente activa que se dedica a la agricultura (que ha descendido, en general, del 18,4% en 1980 al 4,4,% en 2010) la proporción femenina ha aumentado del 28,0% en 1980 al 37,7% en 2010. En tal sólo el 28,8% de las explotaciones la titular es una mujer. (http://www.fao.org/docrep/013/i2050s/i2050s08.pdf).

ha sido también resaltada por otros autores (Rescia et al., 2008) y ampliamente demandada por los ganaderos y ganaderas del caso de estudio aquí presentado (capítulo 4.7).

- Un mayor control e intervención estatal en los mercados, ya que gran parte de la vulnerabilidad que enfrentan actualmente las prácticas agrarias tradicionales, está relacionada con mecanismos y procesos macroeconómicos. Una de las principales transformaciones que se han dado en medio rural agrario en España en el último siglo, ha sido el cambio desde una economía de escala fundamentalmente familiar y local a una economía de mercado (Naredo, 2004; capítulo 4.7). La PAC y su transposición a escala estatal ha apostado por medidas fuertemente sesgadas en favor del establecimiento de los mercados y la producción desproporcionada de excedentes agrícolas que han derivado, durante las últimas tres décadas, en una disminución de la renta real de agricultores y ganaderos, y en la generación de crecientes desigualdades entre grandes y pequeños productores y entre regiones (Von Meyer, 1996; Buckwell, 1996; Comisión Europea, 2002).

5.2.2.3. Pagos por Servicios Ambientales

El potencial para la aplicación en agroecosistemas de Pagos por Servicios Ambientales (PSA, también conocidos como PES por sus siglas inglés, o como PSE) está recibiendo recientemente bastante atención en los foros académicos y técnicos (Tomich et al., 2004; Wunder, 2007; Wunder et al., 2008; Garbach et al., 2012). Los PSA han sido definidos como como cualquier transferencia de incentivos positivos a los proveedores de servicios de los ecosistemas, condicionados igualmente por la prestación de los mismos, y con reflejo social y ecológico de la intervención o adicionalidad [20] (Sommerville et al., 2009).

Entre las normas de obligado cumplimiento y las **medidas agroambientales de la PAC** se encuentran algunas relacionadas con la actividad ganadera que pueden ser en

[20] La adicionalidad es la medida del efecto de la intervención en relación a la situación en que no hubiera habido intervención (Sommerville et al., 2009).

cierta medida comparadas a los PSA (Puente, 2011). En concreto, las ayudas agroambientales de la PAC son compromisos renovables por un periodo de 5 años a través de los cuales los beneficiarios están obligados a adoptar prácticas agrarias compatibles con la conservación de la biodiversidad, que exigen una gestión singular de las explotaciones más allá de la condicionalidad general de la PAC (MARM, 2009), y que sean beneficiosas o mantengan usos del suelo que redundan en la generación y mantenimiento de servicios de los ecosistemas. Algunas de estas medidas están empezando a adoptar la forma de PSA (Dobbs y Pretty, 2008).

Sobre **las ventajas y desventajas del desarrollo de PSA** existe un activo debate en la literatura científica. Por un lado, algunos autores argumentan que la degradación de los servicios de los ecosistemas puede frenarse a través de estas estrategias, a la vez que se generan otros beneficios como contribuir (1) a combinar intereses públicos y privados (ej. Ferraro y Kiss, 2002; Wunder, 2005; Garbach et al., 2012), (2) a aliviar la pobreza (Pagiola et al., 2005; Bulte et al., 2008), (3) a modificar el comportamiento de agricultores y ganaderos hacia prácticas agrarias más sostenibles (Garbanch et al., 2012), y (4) a acercar los mundos rural y urbano mediante la transferencia de fondos desde los consumidores a los proveedores de los servicios (Pagiola et al., 2005; Gutman, 2007). Otros autores, en cambio, sugieren que podría ser contraproducente esperar que los PSA alivien contemporáneamente la pobreza y la degradación ambiental (Wunder, 2008), resaltando además (1) los riesgos de mercantilización de servicios de los ecosistemas (Gómez-Baggethun et al., 2010), o (2) el fenómeno del "fetichismo de la mercancía"[21] (Marx, 1867; Kosoy y Corbera, 2010). Finalmente, tal y como reflexiona Puente (2011), se podría considerar que la práctica ganadera "*constituye una unidad generadora de un flujo de servicios pero, para poder subvencionarlo desde la perspectiva y espíritu de los PSA, no sería aceptable la equivalencia "más ganado = más servicios"*.

En la presente Tesis Doctoral, especialmente en el capítulo 4.7, se han abordado algunas cuestiones de interés sobre la relación entre los servicios de los ecosistemas vinculados a la ganadería extensiva y la trashumancia, y la posibilidad de la implementación de PSA en la zona de estudio. Existe una **percepción socio-cultural de**

[21] El concepto del "fetichismo de la mercancía" fue acuñado por Marx (1867) y definido como el fenómeno social/psicológico en una sociedad productora de mercancías, en que éstas aparentan tener una voluntad independiente de sus productores, enmascarando así las relaciones sociales subyacentes al proceso de producción.

los subsidios diferente a la que se tiene de los PSA. Los **subsidios** se consideran una fuente de ingresos necesaria para la viabilidad económica del sector agrario europeo en el mercado global, es decir para sostener la economía de las explotaciones frente a la creciente competencia en el mercado con productos de otros países (como es el caso de la carne de cordero de Nueva Zelanda). Sin embargo, la pérdida de explotaciones por abandono o jubilación sin reducción de la cabaña total, responde a que muchos rebaños incorporan cabezas para acceder a más ayudas o al traspaso de derechos (Puente, 2011). Los **PSA**, en cambio, se perciben como el reconocimiento, por parte de la sociedad, de la contribución ambiental que realiza la ganadería extensiva y los servicios que generan los ecosistemas a ella vinculados. En este contexto surgen una serie de preguntas.

¿Son mejores los PSA o los subsidios en términos de sostenibilidad socio-ecológica de las explotaciones ganaderas y del suministro de servicios de los ecosistemas? En nuestra opinión, la idoneidad de una medida de apoyo monetario u otra vendría dada por el contexto y la forma en que se implementan. Partiendo de la base de que el análisis de viabilidad de los PSA no constituye el objetivo central de esta Tesis Doctoral, nos atrevemos a manifestar que, en nuestro caso de estudio, es necesario y deseable mantener el apoyo económico y que la forma de PSA podría constituir una herramienta útil para ello (capítulo 4.7). Hasta el momento la forma de subsidio y las ayudas agroambientales no parecen haber tenido mucho éxito. En la zona de agostada (núcleo de origen de la trashumancia en la Cañada Real Conquense) la llegada de los primeros subsidios de la PAC tuvo un gran impacto económico y social (en gran medida motivado por una casi inexistente campaña de información sobre los objetivos y motivaciones de los pagos) que ha tenido un serio efecto rebote y ha generado una gran dependencia. Actualmente, si bien los ganaderos y ganaderas tienden a mostrar preferencias por la autosuficiencia a partir de la justa valoración de sus productos (capítulo 4.7), no se puede obviar un pasado tan relativamente reciente y eliminar las ayudas. Desde el punto de vista de los servicios de los ecosistemas, sin embargo, cabe reflexionar sobre si es posible y deseable fomentar un cambio de mentalidad de los ganaderos, de forma que perciban como “productos” de su actividad, no sólo los servicios de abastecimiento, sino también los de regulación y los culturales que contribuyen a generar/mantener.

Llegados a este punto, resulta justo preguntarse: **¿podrían existir PSA “transicionales”, es decir, pagos que hagan posible la viabilidad económica de la ganadería extensiva en el corto plazo pero que no hipotequen su independencia**

indefinidamente? Si eso es posible, sería idealmente la mejor opción para quienes ya están en activo. Quienes quisieran comenzar podrían, o bien hacerlo en igualdad de condiciones que los demás, o bien hacerlo sin pagos[22], rentabilizando la actividad tan sólo a costa de la venta de productos (según la lógica actual de "productos = servicios de abastecimiento"). En caso de que no exista esta forma de pagos "transicionales" es poco probable que los ganaderos logren la rentabilidad económica en el seno del mercado convencional en competición con quienes sí reciben ayudas, por lo que resulta difícil imaginar vías de escape a una economía agraria subsidiada. Parece, por tanto, que los incentivos económicos generan una "trampa" de la que resulta muy complicado salir y pueden incluso promover inequidades (Heikkinen et al., 2012).

Por otro lado, **¿qué efectos podrían causar los PSA en el contexto estudiado?** Es de esperar que se dieran cambios en las instituciones y las formas de toma de decisiones, así como en las relaciones de poder. Por un lado, es de esperar que se establecieran inequidades entre quienes pueden/quieren acceder a los PSA y quienes no. Por otro lado, podrían quedar invisibilizadas algunas instituciones no formales, por ejemplo los acuerdos en los repartos de pastos. Finalmente, también podrían darse cambios en las motivaciones subyacentes a las prácticas agrarias, de producir principalmente servicios de abastecimiento a producir otro tipo de servicios como los recreativos.

En el caso de la ganadería extensiva en España, donde en muchas ocasiones los ganaderos y/o pastores no son propietarios de la tierra **¿qué tipo de PSA se podría implementar en que el pago no fuera necesariamente ligado al propietario de la tierra sino al responsable y ejecutor de la práctica?** En este sentido, resulta evidente que se hacen aún más necesarios mecanismos de control fiscal que impidan que los dueños de la tierra, a sabiendas del ingreso de los ganaderos a través de los PSA, suban proporcionalmente el precio de los arrendamientos.

¿Y qué sucedería si, por el contrario, se eliminaran todos los pagos? Imaginemos que ningún productor cobrara ya ningún tipo de incentivo, pero siguiera habiendo demanda de productos de origen ganadero. Imaginemos, asimismo, que la capacidad de transporte de los alimentos se viera crecientemente limitada por el excesivo coste del

[22] Éste es el caso de algunas incorporaciones recientes de jóvenes que, ya sea por no tener acceso a los derechos correspondientes o bien por evitar complicaciones burocráticas o por motivaciones políticas o ideológicas, no solicitan ayudas.

combustible y porque los ecosistemas que se están explotando para producir alimentos en otros lugares del mundo (con los que los productos locales compiten en el mercado) comenzaran a mostrar signos de agotamiento inevitable, ni si quiera compensable con el apoyo de la tecnología. En ese escenario, ¿podrían darse formas de reajuste entre el precio percibido por los productores (para que la actividad sea económicamente sostenible) y el precio pagado por los consumidores? En este sentido, las alternativas que se están proponiendo y construyendo desde la Agroecología y la Soberanía Alimentaria resultan interesantes (para una discusión sobre dichas alternativas véase la sección 5.2.2.4).

En resumen, los PSA se pueden considerar como un complemento útil para la posible reconfiguración de las relaciones entre instituciones, comunidades y mercados (Vatn, 2009). Ya existen ejemplos concretos de PSA en España en relación a ganadería como el de la prevención de incendios a partir del control de combustible vegetal mediante pastoreo (ej. Red de Áreas Pasto-Cortafuegos Andalucía[23]) de los que se pueden extraer muchas lecciones Los PSA pueden incentivar prácticas agrarias tradicionales como la trashumancia, relacionadas con la generación de un conjunto de servicios. Sin embargo, para no desvirtuar los pagos sería necesario matizar el papel funcional y la dimensión cultural del ganado en cada contexto socio-ecológico, estableciendo las capacidades de carga en los diferentes ecosistemas, identificando a los actores involucrados, y estableciendo por último un sistema racional de pagos acorde al tipo de manejo más adecuado (Puente, 2011). En resumen, a partir del trabajo de campo realizado en la zona de estudio y de las reflexiones de otros autores (Puente, 2011; Garbanch et al., 2012; Bryan 2013), se recomiendan las siguientes **acciones previas a la implementación de cualquier esquema de PSA relacionado con la ganadería extensiva o la trashumancia**:

- **explorar ventajas e inconvenientes** de dos posibles opciones (no excluyentes): el **pago por un servicio** determinado estrechamente vinculado a la práctica

[23] La Red de Áreas Pasto-Cortafuegos es un programa dirigido por la Dirección General de Gestión del Medio Natural de la Consejería de Agricultura, Pesca y Medio Ambiente de la Junta de Andalucía que consiste en el empleo de ganado en régimen de pastoreo controlado para eliminar el combustible vegetal de las zonas de cortafuegos y mantener las infraestructuras de cara a la prevención de incendios forestales. Un equipo técnico se encarga del funcionamiento de dicha red, determinando las zonas más apropiadas en coordinación con el INFOCA y seleccionando, bajo estrictos criterios técnicos, a los ganaderos, vinculados mediante contratos anuales o aprovechamientos de pastos, para posteriormente valorar la acción de los mismos.

agraria (ej. prevención de incendios) o el **pago a la actividad agraria tradicional** (ej. trashumancia a pie) en virtud del conjunto de servicios de los ecosistemas que contribuye a proveer;

- **analizar distintos servicios de los ecosistemas susceptibles de ser objeto de esquemas de PSA**, con el objetivo de identificar aquellos con mayores beneficios para el conjunto de la sociedad y no para intereses privados;

- **explorar la posible acogida de los PSA entre ganaderos**, así como las posibles motivaciones a participar o no participar en este tipo de programas;

- explorar **cómo podrían interaccionar los PSA con procesos sociales** que influyen en la adopción de comportamientos por parte de los ganaderos;

- realizar un **análisis institucional** que permita conocer mejor los procesos de toma de decisiones e identificar las relaciones de poder existentes entre actores sociales e instituciones formales e informales;

- **identificar posibles *trade offs*** entre el **beneficio** obtenido y el **esfuerzo** requerido y la complejidad añadida en el manejo;

- **explorar opciones de diseño e implementación de PSA mediante co-gestión adaptativa** en los que el seguimiento y la evaluación de la condicionalidad se hiciera de manera participativa e incorporara tanto criterios y conocimientos técnico-científicos, como propios de los saberes y las identidades locales;

- **apoyar la comunicación entre ganaderos de distintas zonas**, entre aquellos que estén ya implicados en planes parecidos de PSA y los potenciales nuevos proveedores (estrategia campesino-a-campesino);

- **mejorar el conocimiento sobre posibles impactos de los PSA en el cambio de usos del suelo** y sus efectos en la generación de servicios de los ecosistemas.

5.2.2.4. Alternativas desde la Agroecología y la Soberanía Alimentaria

Si bien las políticas agrarias del Norte global vienen promoviendo desde el último siglo la industrialización y financiarización de la agricultura y la ganadería, existen **voces críticas** con este modelo que han ido paralelamente denunciando sus consecuencias negativas y **proponiendo alternativas**, fundamentalmente desde el pensamiento social agrario[24] (Sevilla Guzmán, 2013) y, en concreto, desde la Agroecología (como marco de trabajo a caballo entre la academia y los movimientos sociales) y desde la Soberanía Alimentaria (como movimiento político de origen campesino).

La **Agroecología** pretende: (1) el manejo ecológico de los ecosistemas, (2) construir sistemas agroalimentarios locales mediante acciones endógenas, (3) generar procesos de transformación y sostenibilidad social tanto para productores como para consumidores, (4) generar procesos de desmercantilización y democratización del conocimiento mediante la acción articulada con los movimientos sociales y (5) dinamizar participativamente procesos de transición agroecológica (Altieri, 1985; Sevilla Guzmán y Graham Woodgate, 1997; Gliessman, 1998; Sevilla Guzmán, 2013). Asimismo, aunque la Agroecología no ha incorporado hasta ahora un enfoque de género explícito, su mirada crítica facilita la incorporación de la visión ecofeminista y, por tanto, la visibilización de las inequidades de género (García Roces y Soler Montiel, 2010).

A escala global la estrategia agroecológica busca la transformación política socio-ecológica, con el objetivo de alcanzar la **Soberanía Alimentaria** (Sevilla Guzmán, 2013). En 1996, en la Conferencia Mundial sobre la Alimentación de la FAO en Roma, la Vía Campesina[25] presentó su declaración titulada "Soberanía alimentaria, un futuro sin hambre"[26] en la que definía su marco político alternativo a la globalización agroalimentaria desde movimientos sociales de todo el mundo para la gobernanza de la alimentación y la agricultura, y como modelo de desarrollo rural, partiendo de los problemas centrales del hambre y pobreza. Entre el campesinado, sin embargo, ganaderos y pastores a menudo

[24] Según Sevilla Guzmán (2013) "el pensamiento social agrario alternativo puede ser definido como el conjunto de propuestas que se enfrentan al modelo productivo agroindustrial actualmente hegemónico a lo largo de su configuración histórica, criticando el desarrollo del capitalismo en la agricultura y sus impactos sociales y medioambientales."
[25] *La Vía Campesina* es una organización internacional, fundada en 1992, resultado de la alianza de unas 150 organizaciones de productores, trabajadores agrícolas, mujeres rurales y pueblos indígenas en unos 70 países, tanto en industrializados como periféricos (www.viacampesina.org).
[26] http://www.nyeleni.org/spip.php?article38.

adolecen de escasa capacidad de organización para la acción colectiva necesaria para ejercer presión política en la toma de decisiones (Pavanello, 2009), por lo que representan un "voto minoritario" (Hesse y Odhiambo 2006) -si bien en el caso de la Península Ibérica no siempre fue así (Ruiz y Ruiz, 1986; capítulo 4.7)-[27]. La integración de pastores y ganaderos en los órganos de representación política, desde sindicatos a foros internacionales, resulta fundamental para desarrollar estrategias de manejo efectivas para el mantenimiento de la trashumancia y la ganadería extensiva en general (capítulo 4.7). En la actualidad, en España, el gremio de ganaderos en extensivo no está siendo capaz de transformar la percepción que la sociedad tiene del pastoralismo y la trashumancia y transmitir la racionalidad que subyace a la actividad así como su demostrado valor socio-ecológico. Si bien existen algunas iniciativas de movilización (ver más adelante), éstas están más focalizadas a la venta de productos con denominación de origen o la conservación de determinadas razas ganaderas autóctonas que a la acción política (capítulo 4.7).

Gran parte de la aproximación aplicada en esta Tesis Doctoral al estudio de las prácticas agrarias tradicionales en la cuenca mediterránea, así como muchas de las propuestas que emanan de este trabajo, tanto epistemológicas y metodológicas, como políticas, convergen o se complementan con los paradigmas de la Agroecología[28] y la Soberanía Alimentaria. Por tanto, consideramos que ambos paradigmas y las Ciencias de la Sostenibilidad muestran un gran potencial de enriquecimiento mutuo. En concreto, la perspectiva desde la teoría de los sistemas complejos, la vocación transformadora, la importancia crucial de la transdisciplinariedad, la participación de todos los actores sociales, y la legitimación de los saberes locales tradicionales, constituyen las piedras angulares que sirven de puente entre la Agroecología y las Ciencias de la Sostenibilidad.

[27] Tal y como se ha visto, en el pasado hubo momentos en que el gremio ganadero alcanzó llegó a ostentar bastante poder y sus instituciones, sobre todo la Mesta, alcanzaron una gran capacidad de influencia política y económica.

[28] Sevilla Guzmán (2013) recuerda que "es la Economía Ecológica quien, primero desde su crítica radical al erróneo funcionamiento económico del mundo (interpretado desde la impotencia de la economía convencional: cfr. Aguilera Klink, 2012), introduce una dimensión interdisciplinaria global; para después llegar a la transdisciplinaridad desde la ciencia postnormal (Martinez Alier, 2005). Desde la Ecología (Gliessman, 1998); la ciencias agrarias, en general (Altieri, 1985) y las ciencias sociales (Guzmán et al., 2000) van apareciendo aportaciones que culminan en la última década con la propuesta de Boaventura de Sousa Santos." Se puede por tanto ver que la Agroecología y las Ciencias de la Sostenibilidad comparten gran parte de sus principios.

Resumiendo, los alimentos son considerados hoy en día en gran medida como meras mercancías o como activos financieros objeto de especulación (de Schutter, 2010). **Desde los paradigmas y propuestas de las Ciencias de la Sostenibilidad con los que se ha trabajado en la presente Tesis Doctoral es posible reclamar la atención pública para la transformación de las políticas agrarias hacia aproximaciones sistémicas que consideren a los agroecosistemas como sistemas complejos de seres humanos en la naturaleza, en vez de como meras fábricas de alimentos o de mercancías**.

5.2.3. Ganadería extensiva y trashumancia en el contexto estatal

5.2.3.1. De la idea bucólica a la realidad inmediata

A lo largo de esta Tesis Doctoral (capítulos 4.2 a 4.7), se viene mostrando cómo la trashumancia sigue siendo una práctica agraria tradicional viva e importante que ha mostrado un gran resiliencia socio-ecológica y que puede incluso verse revitalizada en el actual contexto de cambio global (capítulo 4.7; Herzog y Bunce 2004; Rescia et al. 2008; Fernández-Giménez y Fillat Estaque 2012). La **sostenibilidad socio-ecológica de la trashumancia**, puede sintetizarse en los siguientes seis elementos:

- Adaptación y acoplamiento a los ecosistemas que la sustentan (capítulo 4.5)
- Adaptabilidad frente cambios socio-ecológicos (capítulo 4.7)
- Conservación de los ecosistemas que la sustentan (ej. redileo, capítulo 4.6)
- Limitada necesidad de insumos (capítulo 4.6)
- Producción descentralizada de alimentos (capítulo 4.7)
- Conservación de memoria-socio-ecológica (capítulo 4.6)

En la aproximación adoptada en la presente Tesis Doctoral, especialmente en el capítulo 4.5, se han explicitado las necesarias preguntas de "resiliencia de qué" y "resiliencia frente a qué" (Carpenter et al., 2001). Queda en parte pendiente, sin embargo, la pregunta de ¿"cuánta resiliencia"? (Kinzig, 2012). En este punto, cabe preguntarse si la resiliencia de la trashumancia en España ha sido siempre la misma y si en la actualidad tiene mucha o poca frente a los distintos impulsores de cambio que amenazan. La respuesta, como el mismo sistema objeto de estudio, es compleja. La resiliencia del socioecosistema disminuye presumiblemente en tanto que se pierde la práctica de la trashumancia y con ella el conocimiento ecológico tradicional vinculado a la misma.

Sin embargo, quizás aunque se pierda resiliencia a nivel de esta práctica, esta mayor vulnerabilidad redunda en una mayor resiliencia a otro nivel. En lo inmediato, la alarma frente a la pérdida aparentemente irrefrenable de la trashumancia redunda en su "**bucolización**" (ej. en los documentales o los centros de interpretación), ha fomentado su **patrimonialización** (por ejemplo, como Bien de Interés Cultural en Aragón), e incluso ha potenciado un mayor **interés de investigación** por la misma. Estos tres procesos (estrechamente ligados entre sí) pueden estar contribuyendo a mantener las formas relictas de la trashumancia y su visibilidad para el conjunto de la sociedad, como formas de "actividad latente" que permiten la conservación de los conocimientos (como el conocimiento ecológico tradicional), las infraestructuras (como la red de vías pecuarias), las instituciones (como la Ley de Vías Pecuarias, o las comunidades de pastos) y los recursos materiales (como los rebaños de oveja merina altamente adaptados a la trashumancia), que son imprescindibles para la posible revitalización de la actividad.

La **actual coyuntura** de crisis económica en España, unida a (1) el encarecimiento de los combustibles fósiles y los piensos, (2) el surgir de cooperativas y grupos de consumo responsable en todo el territorio, (3) la proliferación de escuelas de pastores que se han fundado en los últimos años en Andalucía, Aragón, Asturias, el País Vasco y Cataluña, (4) la articulación de algunas plataformas de cooperación y coordinación entre ganaderos[29] y (5) el repunte de una tímida vuelta de la ciudad al campo que se está dando en los últimos años, podrían suponer un soplo de aire fresco para las actividades agrarias tradicionales. En el caso de la trashumancia (especialmente la trashumancia a pie), aunque resulta incierta la influencia de estos factores en su **revitalización**, se puede afirmar que si no fuera por esas formas latentes de pervivencia, la esperanza de su mantenimiento estaría prácticamente perdida. Durante los años en que se ha realizado la

[29] Algunos ejemplos son la Asociación por la Avileña Negra Ibérica, la Federación Estatal de Pastores o algunos grupos regionales como Pastores por el Monte Mediterráneo, la Asociación de Ganaderos Trashumantes de Asturias, la Asociación Andaluza de la Trashumancia, o la Asociación Nueva Mesta de Albarracín.

presente Tesis Doctoral, un total de cinco explotaciones han comenzado a hacer la trashumancia a pie de nuevo desde los Montes Universales; una de ellas, completamente nueva como trashumante. Es posible por tanto, que en un nivel superior al "local", la resiliencia de la red socio-ecológica sea bastante elevada. La resiliencia de la red socio-ecológica depende de que nuevas iniciativas se asienten en los territorios (que no se pierda el relevo generacional), que éstas tengan buena acogida y que ganen visibilidad frente a las instituciones formales responsables de las políticas que afectan al sector, y, sobre todo, frente al conjunto de la sociedad.

Entre las estrategias prioritarias de acción para el mantenimiento de la resiliencia socio-ecológica ligada a la trashumancia, los resultados de la presente Tesis muestran la necesidad de fomentar la **cooperación y** el **asociacionismo entre ganaderos** (capítulo 4.7). De hecho, el apoyo mutuo resulta un elemento fundamental para el funcionamiento del modelo ganadero trashumante (González et al., 2012). En este sentido, además de las propuestas presentadas en el capítulo 4.7, estrategias del tipo campesino-a-campesino, como se proponen desde la Soberanía Alimentaria pueden resultar clave. En concreto, el contacto e intercambio de saberes y visiones (ej. a través de encuentros anuales de pastores) entre jóvenes ganaderos de "herencia trashumante" y jóvenes recién incorporados a la actividad, puede resultar de vital importancia para la transmisión de conocimientos locales y tradicionales y el empoderamiento del colectivo con vistas a futuro y, por tanto, para la resiliencia del sistema.

Un aprendizaje al respecto, es que **resulta fundamental mantener vivo el mensaje de la relevancia de prácticas agrarias tradicionales (como la trashumancia) para la sostenibilidad socio-ecológica, tanto en los nuevos debates, lenguajes y contextos de investigación como en la esfera política, considerando desde la escala local hasta la internacional.** Si sistemas agrarios tradicionales como la trashumancia siguen vivos en España a pesar de los peores vaticinios desde hace más de 40 años, no resulta descabellado pensar que puedan seguir enfrentando la incertidumbre del cambio global igual o mejor que otros sistemas más tecnificados e intensivos en el uso de insumos. La memoria socio-ecológica de estos sistemas milenarios no sólo es una fuente de conocimiento sobre las adaptaciones de los socioecosistemas desde la prehistoria, sino que puede alumbrar el camino hacia un mejor conocimiento de los mecanismos de innovación y adaptación frente a los cambios.

Sin embargo, el hecho de que la trashumancia haya sido largamente estudiada y muchos de los mensajes clave de esta Tesis Doctoral no sean nuevos (ver por ejemplo Herzog et al., 2005), hace imprescindible e interesante reflexionar sobre porqué muchas de las advertencias y las recomendaciones propuestas ya en los años 70 y 80 siguen teniendo vigencia hoy, qué mensajes, en cambio, ya no aplican y qué nuevas propuestas existen. Si bien los principales **impulsores de cambio que afectan a la ganadería** son en gran medida los mismos desde el último siglo (con algunas excepciones como el caso de la reciente financiarización de los alimentos); las propuestas han ido evolucionando. Dichas propuestas podrían agruparse en tres tipos: *de carácter económico, de carácter político/legislativo* (apartado 5.2.2) *y de carácter socio-cultural*. Las propuestas fundamentales, que emanan de la presente Tesis Doctoral a la luz del caso de estudio de la trashumancia en la Cañada Real Conquense (en cierta medida extrapolables a otras prácticas agrarias tradicionales en la cuenca mediterránea), para hacer frente a estos impulsores de cambio se resumen en la Tabla 5.2.

Tabla 5.2. Propuestas que emanan de la presente Tesis Doctoral con vistas a la conservación y fortalecimiento de la trashumancia (en cierta medida algunas de ellas extrapolables a otras prácticas agrarias tradicionales) y los socioecosistemas asociados a ésta.

Ambito de actuación	Propuestas
Económico	• La posibilidad coyuntural de la implementación de esquemas de Pagos por Servicios Ambientales • El acortamiento de los circuitos de comercialización de los productos • La transparencia de la cadena de comercialización de los alimentos [30] • El control de los precios pagados a los ganaderos [31] • La diversificación de productos comerciales • El control fiscal de los arrendamientos de tierras • El fomento de la des-industrialización agraria • El establecimiento de medidas e instrumentos necesarios para garantizar precios justos a los productores (ej. precios de referencia, protección en frontera o preferencia comunitaria, compras y almacenamiento público)
Político/legislativo	• La mejora de la coordinación entre administraciones públicas • El abordaje y corrección de las incoherencias entre políticas económicas, sociales y de conservación • La mejora de la presencia del gremio ganadero en foros políticos, desde sindicales hasta gubernamentales • La instauración de instituciones de custodia de las prácticas agrarias tradicionales (ej. defensor del trashumante) • El mantenimiento de la autonomía de las formas locales de gobernanza • La salvaguarda de los bienes y servicios públicos y comunales en el medio rural • La reapertura de infraestructuras públicas de procesamiento (ej. mataderos municipales) y almacenamiento • La apuesta por un cierto grado de redundancia institucional que facilite la resiliencia socio-ecológica de los sistemas agrarios
Socio-cultural	• La mejora de la cooperación entre ganaderos/as • La formación de ganaderos y ganaderas • La aplicación de la perspectiva de género a la problemática subyacente al declive de las actividades agrarias tradicionales • La facilitación de la vida familiar en el medio rural en torno a las prácticas agrarias (especialmente en el caso de poblaciones trashumantes) • La puesta en valor del conocimiento ecológico tradicional • La sensibilización social en relación al estrecho vínculo entre el bienestar social e individual y la conservación de los agroecosistemas y las prácticas agrarias que los sustentan • La concienciación y educación social a cerca de los impactos socio-económicos y ambientales de diferentes modelos de producción y patrones de consumo de alimentos • La visibilización y fortalecimiento de la conciencia política de ganaderos/as y agricultores/as

[30] Un tercio de los encuestados en el caso de la Cañada Real Conquense estaría dispuesto a pagar un precio mayor, de un 16% más por kg de media, por la carne de cordero trashumante, lo cual podría suponer una mejora considerable de la rentabilidad económica de la actividad (González et al., 2012).

[31] Según García (2008), se estima que la diferencia entre lo que paga el consumidor y lo que se remunera a una producción ganadera familiar en el Estado español es de 324%. Según cálculos propios aproximados, en la zona de estudio, el diferencial medio actualmente, en el caso de la carne de cordero es del 480%.

5.2.3.2. La dialéctica rural-urbano: las prácticas agrarias tradicionales como puente

La industrialización que ha tenido lugar en el último siglo camina en paralelo al incremento de la urbanización, donde se percibe el mayor porcentaje del aumento de la renta y, por tanto, (1) crece fuertemente la demanda de alimentos, (2) aumentan las exigencias de regularidad en el abastecimiento, (3) se homogeneiza la demanda en cuanto a la calidad y la tipología de los alimentos, (4) se incrementa el grado de transformación de los productos agropecuarios, (5) se expanden las cadenas comerciales y (6) se integra el sector agrario en la economía monetaria (Rodríguez Zúñiga et al., 1980; González de Molina y Toledo, 2011). La consecuencia inmediata de estos cambios es, como se ha visto en el capítulo 4.7, la decadencia de los mercados locales, los canales "primitivos" de distribución y comercialización de productos agrarios tradicionales y las pequeñas explotaciones (Rodríguez Zúñiga et al., 1980).

En la medida en que la población (tanto a escala mundial como a escala estatal) se vuelve cada vez más urbana, la **demanda de servicios de los ecosistemas** se hará previsiblemente **cada vez más urbana**. Por otro lado, las cosmovisiones más frecuentes entre las poblaciones urbanas tienden mostrar una desconexión cognitiva de su bienestar respecto de los ecosistemas, percibiéndolos como factores externos (Folke te al., 2011; capítulo 4.7). Esto tiene serias implicaciones en relación a la sostenibilidad socio-ecológica, pues tal y como se ha visto existen *trade-offs* entre los servicios percibidos (la demanda) por las poblaciones urbanas y las rurales. En el caso de los agroecosistemas de la cuenca mediterránea, algunos de los servicios demandados desde las poblaciones urbanas están inextricablemente unidos a determinadas prácticas agrarias (ej. los usos recreativos de las cañadas para ciclismo o paseos, o la prevención de incendios en la zona de agostada), cuya supervivencia en cambio se ve amenazada por impulsores de cambio especialmente vinculados, por un lado, a decisiones políticas tomadas desde el medio urbano y, por otro, al estilo de vida propio de las poblaciones urbanas (capítulo 4.7). La población urbana en España en la actualidad constituye más del 80% del total (MARM, 2011), por lo que se explica el mayor peso político y socio-económico en la toma de decisiones. Sin embargo, el bienestar de esa población urbana depende fundamentalmente de ecosistemas mantenidos por las prácticas de las poblaciones del medio rural en España y más allá de las fronteras estatales (EME, 2011).

Los impulsores de cambio que más afectan actualmente a la pervivencia de las prácticas agrarias tradicionales en la cuenca mediterránea se generan desde la escala regional (ej. transposición de las ayudas de la PAC), la escala nacional (ej. interés económicos y políticos prioritarios) y las escalas europea y global (ej. negociaciones y tratado comerciales, mercados). La intensidad y el origen multiescalar de estos impulsores subyacen a la continua decadencia de prácticas como la trashumancia. A pesar de que la comunidad científica advierte de las problemáticas ligadas al medio rural y de la importancia de la conservación de las prácticas agrarias tradicionales extensivas por su contribución a la conservación de ecosistemas fundamentales de los que toda la población se beneficia, la decadencia continúa. Las políticas implementadas al respecto resultan en gran medida insuficientes e incoherentes, redundando en el éxodo rural continuado hacia las ciudades y en la terciarización del medio rural, en gran medida para dar respuesta a los servicios demandados por el medio urbano (ej. aire limpio, valor de existencia de la biodiversidad y servicios recreativos), retroalimentando así un bucle perverso.

Si bien no conviene generalizar e idealizar el medio rural en oposición a la demonización del medio urbano, ni olvidar que la realidad es compleja y entre estos dos extremos hay un amplio continuum, es fundamental analizar los recurrentes resultados diferenciados en las percepciones de servicios desde unas y otras poblaciones (ej. las poblaciones en el medio rural tienden a percibir más servicios de los ecosistemas y más diversos) y las consecuencias que esto tiene en relación a los objetivos de las políticas públicas. En este sentido, es preciso considerar que:

- Tal y como se planteaba en los capítulos 4.3 y 4.4, entre los extremos de una gestión para la satisfacción de las demandas y cosmovisiones del medio urbano y el abandono de la tierra y los pueblos, **las prácticas agrarias tradicionales asociadas con formas de manejo de bajo impacto y escasos insumos deberían atraer mayor atención desde la esfera política.**

- Especialmente en el actual contexto político y económico en España, resulta fundamental **salvaguardar la autonomía institucional de las poblaciones del medio rural, responsables en gran medida de la conservación de paisajes culturales multifuncionales (y en concreto los agroecosistemas), así como los derechos de uso y las propiedades comunales y públicas** (ver próximo apartado).

5.2.3.3. La trashumancia como modelo de vida y de gestión del territorio basado en los comunes: retos en el actual contexto político estatal

En muchos lugares del mundo, el pastoralismo y en especial el nómada, está estrechamente ligado a formas comunales de manejo de la tierra (ej. Sulieman, 2013). Los bienes y servicios comunales y las instituciones relacionadas han sido ampliamente valoradas por su fiabilidad frente a la incertidumbre y las perturbaciones (Ostrom, 1990). La puesta en común de recursos, asimismo, ha sido clasificada como una práctica adaptativa que contribuye a la resiliencia de los socioecosistemas (Agrawal, 2008; Gómez-Baggethun et al. 2012; capítulo 4.6).

La Península Ibérica es un claro de ejemplo de este vínculo, ya que según un reciente informe de la Secretaría de la Convención sobre Diversidad Biológica (Couto y Gutiérrez, 2012), las Áreas de Conservación Comunal (ICCAs en inglés) de uso pastoral están entre las más importantes en España. La mayoría de los pastos en España son de uso comunal, especialmente en zonas de montaña, y sus formas de gobernanza son extremadamente antiguas. **Existe aún**, por tanto, **una considerable superficie territorial y una serie de derechos de uso público y comunal que funcionan de soporte imprescindible para la ganadería extensiva y la trashumancia**, tales como los pastos comunales o las vías pecuarias. Este patrimonio **debe su existencia fundamentalmente a cuatro factores**, sobre los que se asienta asimismo la resiliencia socio-ecológica de la práctica:

- El equilibrio dinámico y la **complementariedad entre usos** agrícolas, silvícolas y pastoriles (ej. dehesas en las zonas de invernada o montes públicos en las zonas de agostada), es decir la multifuncionalidad de los ecosistemas;
- La fortaleza de las **instituciones formales** defensoras de los intereses del gremio ganadero (legislación, como la Ley de Vías Pecuarias, y asociaciones, como la Mesta);
- La importancia del **capital social, las redes locales y las instituciones no formales** (ej. formas de democracia participativa directa en concejos vecinales en algunas zonas de la Península Ibérica, asociaciones temporales entre amigos y familiares para hacer los viajes de la trashumancia);

- El **interés comercial** de la actividad ganadera **a distintas escalas**, desde los mercados locales (ej. para la carne y los lácteos) hasta los mercados internacionales (ej. para la lana), que supone la diversificación del riesgo para la sostenibilidad económica de las explotaciones.

Si bien el valor cultural, ambiental y socio-económico de las Áreas de Conservación Comunal es reconocido por la sociedad y apoyado por la administración (Couto y Gutiérrez, 2012), una larga y profunda crisis afecta al sector ganadero extensivo. En España los recursos **comunales** están en muchos casos ligados a las Entidades Locales Menores, actualmente amenazadas por la privatización[32] y por el Anteproyecto de Ley de Racionalización y Sostenibilidad de la Administración Local[33]. Una de las principales amenazas para los movimientos de ganado es la privatización de la tierra (Li y Huntsinger, 2011). En consecuencia, uno de los retos a los que se enfrenta la trashumancia en la actualidad en España es reconocer institucionalmente la importancia de los comunes, así como promover la coordinación institucional de manera que las instituciones formales (tanto mercados como legislación) respeten y favorezcan el mantenimiento de estas áreas y sus formas tradicionales de gestión.

Tal y como se viene defendiendo en la presente Tesis Doctoral, los agroecosistemas mediterráneos deben en gran medida su existencia y funcionamiento a las formas de gestión y las prácticas de manejo que los seres humanos hacen de ellos. Del mismo modo, **las formas de gobernanza y tenencia de la tierra están inextricablemente ligadas a los agroecosistemas y las prácticas, por lo que no se conservarán las unas sin las otras.**

[32] Recientemente se ha hecho pública la posible venta de montes públicos por parte de la Junta de Castilla-La Mancha

[33] Dicho anteproyecto está siendo fuertemente criticado en parte porque puede suponer una amenaza para la autonomía de las instituciones locales y para la conservación del rico y diverso flujo de servicios generados por ecosistemas como los bosques y pastos.

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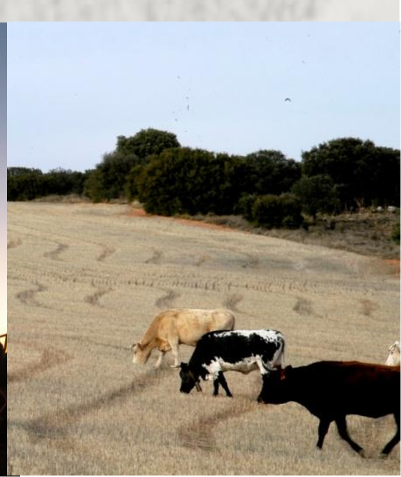
Capítulo 6 Conclusiones





Conclusiones

1. La **aproximación conceptual y metodológica de las Ciencias de la Sostenibilidad**, en particular (1) el marco de los sistemas socio-ecológicos, (2) el concepto de servicios de los ecosistemas y (3) la teoría de la resiliencia socio-ecológica, se han demostrado útiles para tender puentes entre naturaleza y sociedad, así como para combinar diferentes tipos de conocimientos en un marco holístico de investigación interdisciplinar y participativa.

2. La trashumancia se ha conceptualizado como una **red socio-ecológica**, es decir, una red de flujos biofísicos y sociales generados y mantenidos por el movimiento de los pastores y el rebaño. Esta aproximación ha permitido poner de manifiesto los vínculos estrechos, dinámicos, multi-direccionales y multi-escalares que existen entre esta práctica ganadera tradicional y la generación de un flujo diverso de servicios de los ecosistemas.

3. El concepto **de servicios de los ecosistemas** ha permitido subrayar la actual escasa visibilidad de los servicios de regulación y culturales generados por los agroecosistemas mediterráneos en comparación con los servicios de abastecimiento. Asimismo, ha contribuido a identificar *trade-offs*, sinergias y *bundles* de servicios de los ecosistemas.

4. La presente investigación ha mostrado el gran potencial de **las valoraciones socio-culturales** para: (1) identificar un flujo diverso de servicios de los ecosistemas, incluyendo aquellos que no tienen reflejo en el mercado; (2) incorporar vínculos no materiales entre los seres humanos y la naturaleza; (3) visibilizar las preferencias socio-culturales a diferentes escalas de percepción (individual *vs.* social); (4) explorar las diferencias entre actores sociales en la percepción y demanda de servicios de los ecosistemas; (5) analizar los efectos espaciales y temporales de la demanda de servicios de los ecosistemas; (6) identificar tendencias percibidas y alertas tempranas del deterioro de los servicios de los ecosistemas; (7) revelar grupos de servicios que son percibidos conjuntamente y que pueden ser de interés para la gestión; (8) explorar los vínculos entre los servicios de los ecosistemas y las prácticas agrarias tradicionales como la trashumancia.

5. La **teoría de la resiliencia** se ha aplicado como metáfora y concepto híbrido con el fin de aprender del pasado para comprender mejor el presente y los retos futuros a los que se enfrenta la trashumancia. Asimismo, ha resultado de utilidad para explorar cómo la incertidumbre y los impulsores directos e indirectos de cambio pueden influir en la red socio-ecológica.

6. El cuerpo de conocimiento actual relativo a los **servicios de los agroecosistemas mediterráneos** puede contribuir a mejorar la **Política Agrícola Común** con vistas a la actual reforma. Sin embargo, se han identificado algunas asimetrías, en concreto: (1) una escasa aplicación de las valoraciones socio-culturales y los análisis multicriterio; (2) una presencia limitada de estudios que evalúen conjuntos de servicios, (3) reducida participación de los actores sociales en las investigaciones, (4) escasa presencia de procesos de diseño participativo de escenarios de futuro. Estos vacíos pueden poner en peligro los valores de las prácticas agrarias tradicionales y dificultar el desarrollo de políticas de sostenibilidad real.

7. Tanto los elementos humanos/sociales como los no-humanos/sociales o ecológicos en los paisajes de la trashumancia, han atravesado diferentes crisis, reiventándose así la propia red. La trashumancia ha demostrado ser, no sólo una **estrategia adaptativa** en sí misma (basada en la movilidad), sino un **reservorio de conocimiento ecológico tradicional** (incluyendo las prácticas) valioso con vistas a la **adaptación al cambio global.** La exploración de las crisis pasadas y el comportamiento de la red socio-ecológica en respuesta a las perturbaciones, no sólo ha contribuido a comprender la evolución y la estructura de los paisajes actuales asociados a la trashumancia en la cuenca mediterránea, sino también a analizar posibles escenarios de futuro bajo condiciones de cambio ambiental global.

8. A pesar de la existencia de un rico cuerpo **de conocimiento ecológico tradicional** entre los pastores trashumantes, se ha identificado una marcada pérdida entre la generación más joven. El mantenimiento de la **trashumancia a pie** es el factor que más contribuye a la conservación del conocimiento ecológico tradicional. En los países desarrollados, el mantenimiento de las condiciones necesarias para la movilidad de los rebaños puede contribuir a

fortalecer la capacidad adaptativa de las sociedades agrarias para lidiar con el cambio ambiental global.

9. La implementación de diversas **estrategias y medidas**, desarrolladas durante el diseño participativo de escenarios de futuro puede **contribuir al mantenimiento de la trashumancia**. Las cuatro propuestas principales son: (1) la implementación de esquemas de pagos por servicios ambientales, (2) la mejora de la coordinación institucional y el fortalecimiento del capital social entre los trashumantes, (3) la mejora de la comercialización de los productos, y (4) la restauración y conservación de las vías pecuarias.

10. El actual contexto de la **reforma de la Política Agrícola Común** (PAC) para el periodo 2014-2020 podría constituir una oportunidad para mejorar el apoyo a la trashumancia y a otras prácticas agrarias tradicionales que se relacionen con el suministro de servicios de los ecosistemas. El apoyo a los paisajes multifuncionales y a la trashumancia, en virtud de los servicios que contribuye a generar, deberían ser reconocidos debidamente para el diseño de las nuevas medidas agro-ambientales de la PAC.

11. Los **pagos por servicios ambientales** (PSA) pueden resultar interesantes en el caso de la ganadería extensiva (y la trashumancia). Sin embargo, antes de su desarrollo e implementación, deberían llevarse a cabo algunos pasos previos: (1) analizar las posibles ventajas y desventajas del pago por un servicio concreto o por la práctica en sí, (2) identificar qué servicios se acoplan mejor a los esquemas de PSA en el caso de la ganadería extensiva, (3) explorar las posibles interacciones entre los PSA y las instituciones informales, así como sus efectos sobre posibles cambios de usos del suelo, y (4) explorar posibilidades de diseño e implementación de PSA a través de co-gestión adaptativa.

12. Se han identificado **seis elementos fundamentales que refuerzan la sostenibilidad socio-ecológica de la trashumancia**: (1) la adaptación y el acoplamiento a los ecosistemas que sustentan la práctica, (2) la capacidad adaptativa frente a cambios socio-ecológicos, (3) la conservación de los ecosistemas en los que se desarrolla la práctica, (4) la escasa demanda de insumos, (5) la producción descentralizada de alimentos, (6) la conservación

de la memoria socio-ecológica. Sin embargo, actualmente, existen una serie de impulsores de cambio de carácter económico, político/legislativo y socio-cultural, que amenazan la supervivencia de la ganadería extensiva y de la trashumancia.

13. Realizamos algunas **propuestas** que pueden contribuir a la resiliencia de los sistemas socio-ecológicos en los que las prácticas agrarias tradicionales (como la trashumancia) constituyen elementos fundamentales para el mantenimiento del flujo de servicios de los ecosistemas: (1) fortalecer la diversidad de fuentes de ingresos de los pequeños productores agrarios tradicionales en extensivo, (2) reflejar los valores sociales y ecológicos en el valor de mercado de los productos derivados de los sistemas agrarios extensivos, (3) mejorar el reconocimiento social de los servicios de los ecosistemas asociados con los paisajes culturales dependientes de prácticas agrarias tradicionales, (4) reforzar el capital social a través de la reconstrucción de las instituciones locales y el apoyo de los canales locales de comercialización, (5) proteger los bienes y derechos comunales y públicos de los que dependen las actividades agrarias tradicionales, como los pastos comunales o las vías pecuarias, de tal forma que éstos se mantengan accesibles a los ganaderos y agricultores, y (6) desarrollar nuevos marcos institucionales para la gobernanza adaptativa.

Conclusions

1. The **conceptual approach and methodological tool-boxes of Sustainability Science**, in particular (1) the social-ecological systems framework, (2) the ecosystem services concept and (3) the social-ecological resilience theory, have proved to be useful for bridging the society-nature divide and for combining different types of knowledge in an holistic framework of interdisciplinary and participatory research.

2. Transhumance has been conceptualized as a **social-ecological network**, i.e. a network of biophysical and social flows generated and maintained by the movement of herders and livestock. This approach has allowed us to highlight the close, dynamic, multi-directional and multi-scalar links between this traditional livestock management practice and the delivery of a wide range of ecosystem services.

3. The **ecosystem services concept** has allowed the current invisibility of regulating and cultural services of agroecosystems in comparison to provisioning services to be underlined, and has helped identifying trade-offs, synergies and bundles of ecosystem services.

4. The present study has shown the great **potential of socio-cultural valuations** for: (1) identifying a diverse flow of ecosystem services, including ecosystem services that do not have a market value; (2) incorporating non-material links between society/individuals and nature, (3) unraveling socio-cultural preferences at different perception scales (self-oriented vs. other-oriented); (4) exploring differences among stakeholders in the perception and demand of ecosystem services; (5) analyzing spatial and temporal effects on ecosystem service demand; (6) elucidating perceived trends as an early warning of ecosystem service deterioration; (7) revealing perceived bundles of ecosystem services that can inform management; and (8) exploring the links between ecosystem services and traditional management practices (i.e., transhumance).

5. The **resilience theory** has been applied as a metaphor and hybrid concept in order to learn from the past to allow a better understanding of present and future challenges that transhumance is facing, as well as how uncertainty and direct and indirect drivers of change might influence the social-ecological network.

6. Although the current **important body of knowledge regarding ecosystem services delivered by Mediterranean agroecosystems** can potentially contribute to the design of the new Common Agricultural Policy of the European Union, we have found several **asymmetries**, in particular: (1) scant use of socio-cultural valuation methods and multi-criteria analysis, (2) a limited presence of studies evaluating bundles of ecosystem services, (3) little participation of stakeholders in research, and (4) sparse development of scenario planning approaches. These gaps might jeopardize the outstanding values of traditional farming practices and High Nature Value farming areas and hinder the development of truly sustainable management policies.

7. Both human/social nodes and non-human/social or ecological nodes in transhumance landscapes plus their connections have, presumably, passed through different crises, thus reinventing the network. **Transhumance** has proven to be not only an **adaptive strategy** (based on mobility) itself, but a **pocket of traditional ecological knowledge** (including practices) with an **outstanding value for adaptation to global change**. Looking into past crises and the response behavior of the social–ecological network when confronted with disturbances has helped not only to understand the evolution and structure of present transhumance landscapes in the Mediterranean Basin but also to analyze possible future scenarios under conditions of global environmental change.

8. Although a rich body of **traditional ecological knowledge** (TEK) persisted among transhumant shepherds, a marked loss of TEK was found among transhumants born after 1975. The maintenance of **transhumance on foot** was the most important factor influencing TEK preservation. In developed countries, maintaining conditions for herd mobility can contribute to enhance the adaptive capacity of agricultural societies to cope with global environmental change.

9. Several **strategies and measures for the maintenance of transhumance** were developed during the participatory scenario planning process, among which four strategies have been highlighted as the most urgent: (1) the implementation of payment schemes for ecosystem services, (2) the enhancement of institutional coordination and social capital among transhumants, (3) the improvement of product marketing, and (4) the restoration and conservation of drove roads.

10. The current context of the **Common Agricultural Policy (CAP)** reform for the period 2014-2020 could provide an opportunity to improve the support for transhumance and for other traditional farming practices proved to be responsible for ecosystem services delivery. The promotion of **multifunctional landscapes and transhumance preservation** that seeks to guarantee the delivery of a diverse flow of ecosystem services should be considered for the design of future agro-environmental measures in the face of the current CAP reform.

11. Some **payments for ecosystem services (PES)** might be of interest in the case of pastoralism (and transhumance); however, we provide some insights for several steps that should be taken previous to the implementation of PES schemes, such as: (1) analyzing advantages and disadvantages of payments for single ecosystem services or for the farming practice as a whole, (2) identifying what ecosystem services would better fit for PES schemes related to livestock faming, (3) explore possible interaction of PES with local informal institutions and on land-use change, and (4) explore possibilities for PES design and implementation through co-adaptive management.

12. Six **key features** were identified **that reinforce the social-ecological sustainability of transhumance**: (1) adaptation and coupling to the supporting ecosystems, (2) adaptive capacity in the face of social-ecological changes, (3) conservation of supporting ecosystems, (4) limited demand of inputs, (5) decentralized production of food, (6) conservation of social-ecological memory. However, a number of economic, political/legislative and socio-cultural drivers of change that are currently threatening pastoralism and transhumance have been identified and measures and actions are given to face these challenges.

13. We propose some **insights** that might increase the resilience of social-ecological systems where traditional farming practices (such as transhumance) are key elements for maintaining the supply of ecosystem services: (1) strengthening the diversity of income sources for extensive, customary and small-scale farmers; (2) reflecting social and ecological values in the market value of products derived from agrarian extensive systems; (3) improving social recognition of ecosystem services associated with cultural landscapes dependent on traditional practices; (4) reinforcing social capital through rebuilding local institutions and supporting local trade agreements; (5) protecting the commons, like communal pasturelands and the drove roads network, so that these resources remain accessible to farmers and shepherds; and (6) developing new institutional frameworks for adaptive governance.

Anexos

Y, sin embargo, se mueve. La cabaña va. Pertrechados de teléfonos móviles los mayorales, pero no menos indefensos ante las contingencias de la marcha a extremos. Resignados los viejos pastores a un oficio que se muere, pero no poco anhelantes los jóvenes de que les enseñen otros modelos para recoger el testigo. Entonces, convenimos en que la trashumancia vive, pero a trancas y barrancas, marchando por la quebradiza linde entre tradición y modernidad. Los nuevos tiempos la desafían. Necesita nuestra ayuda. Para fortalecer nuestra identidad cultural. Para salvaguardar nuestro patrimonio viario. Para que la Red no devore a la red."

Pedro Gracia Martin Actas. **"La principal sustancia de estos reinos: el honrado concejo de la mesta"**. I congreso de Vías Pecuarias.



Anexo A

Modelo de cuestionario aplicado en el caso de estudio de la Cañada Real Conquense para la valoración socio-cultural de los servicios de los ecosistemas mediante preferencias sociales (capítulos 4.3 y 4.7).

Laboratorio de Socio-Ecosistemas

UAM UNIVERSIDAD AUTONOMA DE MADRID

Valoración económica de la biodiversidad y los servicios ligados a la trashumancia en la Cañada Real Conquense: implicaciones para la gestión de agroecosistemas mediterráneos en el contexto del cambio global.

FECHA .... Nº DE ENCUESTA .... LOCALIZACIÓN ....

Desde la Universidad Autónoma de Madrid trabajamos con los vínculos entre los seres humanos y la naturaleza. En este momento estamos realizando un proyecto en el que tratamos de identificar y analizar los beneficios proporcionados por los ecosistemas vinculados con los movimientos ganaderos trashumantes en la Cañada Real Conquense y cómo son estos percibidos por la población de las zonas de agostada, invernada y paso de la cañada. Nos sería de gran ayuda conocer su percepción a través de esta encuesta. ¿Sería tan amable de contestarla? ¡Muchas gracias!

Identidad cultural/Conocimiento de la trashumancia y la Cañada Real Conquense

1. Lugar de residencia: ....
2. ¿Desde cuándo vive usted aquí? .... años.
3. ¿Sus padres/abuelos eran de esta zona? ☐ SI (municipio: ....)
   ☐ NO (de donde vinieron: ....)
4. ¿Conoce la Cañada Real Conquense, también llamada de los Serranos o de los Chorros...?☐SI ☐ NO
5. ¿De dónde a dónde va la Cañada?

   Extremo norte: .... Extremo sur: ....

   Localidades intermedias: ....
6. ¿Alguna Cañada Real atraviesa este municipio? ☐ SI ☐ NO ☐ NS
7. ¿Qué es para usted la trashumancia?
   ....
   ....
8. Dígame 4 palabras (ideas, elementos, emociones o sensaciones) que usted asocie con la trashumancia:

   1. .... 3. ....

   2. .... 4. ....
9. ¿Pasa todavía ganado trashumante por esta cañada?/¿Hay todavía ganadería trashumante en este municipio? ☐ SI ☐ NO ☐ NS
10. ¿Sabe usted cuantos rebaños han pasado este año:
    a. en primavera? ....
    b. en otoño? ....
11. ¿Conocía o conoce algún ganadero trashumante que la recorra? ¿Quiénes? ....

Percepción y valoración económica de servicios de los ecosistemas

La Cañada Real Conquense atraviesa tres comunidades autónomas diferentes (Aragón, Castilla La-Mancha y Andalucía) y numerosas provincias a lo largo de más de 400 Kms (mostrar mapa con fotos). La zona de agostada del ganado trashumante se encuentra en los pastos de montaña de la Sierra de Albarracín (Teruel) y la Serranía de Cuenca, mientras que la zona de invernada ocupa dehesas de encinas en la zona oriental de la Sierra Morena (Jaén). En su desplazamiento de unos a otros pastos, el ganado trashumante utiliza una vía pecuaria de 75 metros de ancho para atravesar el mosaico agrario de La-Mancha con predominio de cultivo de vid, girasol, olivo y cereal.

La naturaleza reporta de manera directa o indirecta beneficios al bienestar humano, por ejemplo: a través de los arboles obtenemos la madera necesaria para la construcción de mobiliario; algunas plantas fijan el suelo y los taludes; otras especies juegan un papel estético por las flores vistosas, etc.

1. ¿Cree usted que los ecosistemas vinculados a la ganadería trashumante generan alguna clase de beneficios que influyen positivamente en el bienestar humano?

☐ Mucho ☐ Bastante ☐ Poco ☐ Nada

2. Como por ejemplo, ¿cuáles?

……

……

3. Del siguiente **panel**, seleccione tres beneficios y ordénelos en función de cuáles son los más beneficiosos o importantes (siendo el 1 el más y el 3 el menos) para el bienestar de las personas que viven o visitan las zonas antes mencionadas.

Beneficio	*Orden*	*Lugar*			*Época de su disfrute*				*Tendencia (oferta / calidad)*	*Beneficiarios*						*Importancia en su vida (1-4)*
		A	*C*	*I*	*P*	*V*	*O*	*I*		*To*	*L*	*G*	*A*	*Tu*	*O*	

4. Sabiendo que estos beneficios de la naturaleza contribuyen al bienestar humano, en el hipotético caso de que una asociación nacional decidiera crear un fondo para el **mantenimiento de los beneficios que generan los ecosistemas vinculados a la Cañada Real Conquense** y que el fondo estableciera la posibilidad de que la gente contribuyera con una donación voluntaria, ¿estaría dispuesto a hacer una donación económica anual a dicho fondo?

☐ Sí ¿cuánto como máximo? ………………………………€; ☐ No, ¿por qué? ……………………………………………………

5. Elija 4 beneficios del **panel** para los cuáles distribuiría la cantidad de dinero aportada en la pregunta anterior.

1. ……………………………………………………………………… 3. ………………………………………………………………………….

2. ……………………………………………………………………… 4. ………………………………………………………………………

6. Del mismo panel, ¿qué 3 beneficios considera que se verían **más perjudicados si desaparece la trashumancia a pié** en la Cañada Real Conquense?

Beneficio	*Orden*	*Causa/motivo* *(opcional)*

7. Sabiendo que estos beneficios de la naturaleza contribuyen al bienestar humano, en el hipotético caso de que una asociación nacional decidiera crear un fondo para el **mantenimiento de la trashumancia en la Cañada Real Conquense** y que el fondo estableciera la posibilidad de que la gente contribuyera con una donación voluntaria, ¿estaría dispuesto a hacer una donación económica anual a dicho fondo?

□ Sí ¿cuánto como máximo? ………………………………€; □ No, ¿por qué? ……………………………………………

8. En el caso de que pudiese decidir **cómo contribuir al mantenimiento de estos beneficios** ¿de qué forma preferiría hacerlo?

- □ **Donación** económica anual a una organización ambiental para crear un fondo nacional de conservación de la trashumancia en la Cañada Real Conquense.
- □ Pago de **impuestos extras,** que se incorporen a los presupuestos de:
  - □ Ayuntamiento
  - □ Comunidad Autónoma
  - □ Diputación provincial
  - □ Estatal
- □ Destinar un **0.7 %** de la declaración de la **renta**.
- □ Mediante su propio trabajo, dedicando un **tiempo** a labores de apoyo al mantenimiento de los beneficios (educación ambiental, divulgación, restauración…):
- □ Pagando un **precio** mayor por los **productos** que derivan de ganado trashumante:

  ¿Cuánto más por Kg de carne?………. €/………..€/Kg carne habitual, ó
  ¿Qué porcentaje más respecto al precio habitual? …………€.
- □ Pagando por **acompañar a los pastores** y su ganado durante varios días de trashumancia: ¿Cuántos días? ……………………. €. ¿Cuánto pagaría por el viaje? ……………………. €.

- [ ] No estaría dispuesto a contribuir de ninguna de estas maneras. ¿Por qué?

………

¿De qué manera estaría dispuesto a contribuir?

………

Instituciones

1. Nombre y ordene (siendo el 1 el más y el 4 el menos) los 4 grupos/organizaciones que más influyen/deciden sobre la trashumancia en la Cañada Real Conquense y de qué tipo es su influencia actualmente?

Orden	*Actor/Institución*	*Influencia actualmente (+; -; NS)*

Futuro

1. ¿Cómo ve (objetivamente) el futuro de la **trashumancia a pie a lo largo de la Cañada Real Conquense**? (Tendencia: mejora, se mantiene, empeora) ¿Por qué?

   ………

   ………

2. ¿Cómo ve (objetivamente) el futuro de la **Cañada Real Conquense**? (Tendencia: mejora, se mantiene, empeora) ¿Por qué?

   ………

   ………

3. ¿Cómo le gustaría que fuera el futuro de la **trashumancia**? ¿Por qué?

   ………

   ………

4. ¿Cómo le gustaría que fuera el futuro de la **Cañada Real Conquense**? ¿Por qué?

   ………

   ………

5. Señale las 4 cuestiones de la lista que le parecen más importantes para el futuro de **la trashumancia en la Cañada Real Conquense:**

- ☐ Que exista una **legislación** que apoye la ganadería trashumante (Ley de Vías Pecuarias, convenios para la conservación…).
- ☐ Que se controlen las **enfermedades del ganado.**
- ☐ Que existan **organizaciones/instituciones** que apoyen a la ganadería trashumante.
- ☐ Que haya **nuevas generaciones** que quieran seguir dedicándose a la ganadería trashumante.
- ☐ Que haya **subvenciones** para el mantenimiento de la trashumancia.
- ☐ Que se desarrolle **turismo** vinculado a la trashumancia.
- ☐ Que haya un **pago por los beneficios** que la trashumancia genera a la sociedad.
- ☐ Que se reduzcan los **trámites administrativos** para el movimiento del ganado.
- ☐ Que mejoren las **condiciones de vida de los pastores** durante el desplazamiento del ganado.
- ☐ Que mejore la **rentabilidad económica** de la actividad ganadera trashumante.
    - i. Precios de mercado de los productos cárnicos.
    - ii. Precios de mercado del combustible.
    - iii. Disponibilidad de mercado para otro productos no cárnicos (lana, piel).
    - iv. Intermediarios.
- ☐ Que haya **mano de obra** disponible para el pastoreo.
- ☐ Que mejore el **estado de la Cañada** (ancho suficiente de la Cañada, con otros usos no compatibles con el paso del ganado: sin invasiones agrícolas, escombreras, infraestructuras urbanas…).
- ☐ Que la Cañada Real tenga **otros usos** (deporte, turismo, fiestas populares, recolección de productos…)
- ☐ Que haya **organización / cooperación entre los ganaderos** trashumantes.

Variables de comportamiento ambiental

1. ¿Es usted miembro de alguna asociación?

    ☐ Sí, ¿de qué tipo? (Ambiental; Social; Ocio; Trabajo; Otras) ¿Cuál?

2. ¿Ha visitado Vd. algún/os espacio/s natural/es a lo largo del 2008/2009?

    ☐ No ☐ Sí, ¿cuáles?

    ....

3. ¿Usted lee revistas u otras publicaciones de tipo ambiental?

    ☐ Siempre ☐ Rara vez

    ☐ A menudo ☐ Nunca

4. ¿Usted compra o consume alimentos producidos de agricultura ecológica y/o comercio justo?

    ☐ Siempre ☐ Rara vez

    ☐ A menudo ☐ Nunca

5. ¿Con qué frecuencia separa usted la basura? ¿cuál? (vidrio, envases, papel, pilas, orgánico)

    ☐ Siempre ☐ Rara vez

    ☐ A menudo ☐ Nunca

    ☐ Nunca (pero lo haría si el municipio tuviera contenedores o hubiese más facilidades para ello)

Variables socio-económicas

1. ¿Podría decirme cuál es su nivel de estudios?

☐ Primarios ☐ Universitarios ☐ Secundaria / Bachillerato ☐ Ninguno

2. ¿Podría decirme su edad? ……………………………… años
3. ¿Cuál es su profesión? ………………………………………………………………………………………
4. ¿Está usted relacionado de alguna manera con ganadería/agricultura etc)? Especificar vínculo
5. ¿Dentro de qué intervalo se incluyen sus ingresos mensuales individuales netos?

☐ < de 700 € (<116.200 pts)

☐ 700 – 1.400 € (116.200-232.400pts)

☐ 1.401 – 2.100 € (232.401- 348.600 pts)

☐ 2.101 – 2.800 € (348.601-464.800 pts)

☐ 2.801 – 3.200 € (464.801-531.200 pts)

☐ > de 3.200 € (> 531.200 pts)

6. ¿Cuántos miembros viven actualmente en su casa? ………………………………………………………

Sugerencias o comentarios

……

……

……

……

A rellenar por el encuestador:

• Lugar de la encuesta: ………………………………………………………………

• Actitud del encuestado: buena / indiferente / poco dispuesto

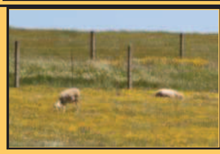
• Entendimiento del cuestionario: alto / medio / bajo

• Sexo del encuestado: hombre / mujer

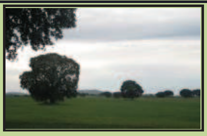
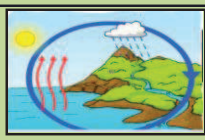
Anexo B

Paneles utilizados durante la aplicación del cuestionario del ANEXO A (capítulo 4.3) para la explicación de los servicios de abastecimiento (B.1), regulación (B.2) y culturales (B.3).

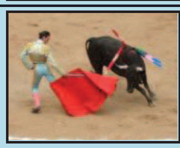
Anexo B.1

Beneficios que el ser humano obtiene de la naturaleza de manera directa a través del ABASTECIMIENTO de productos		
Beneficio	***Ejemplo***	***Foto***
Recolección	Setas, espárragos, collejas, caracoles, bellotas, cardillos, cascarrias, etc.	
Abono	Restos fecales de animales para abonar cultivos	
Alimento para animales	Pastos y forraje	
Apicultura	Miel	
Alimento de caza	Perdices, liebres, conejos, jabalíes, etc.	
Ganado	Carne y lácteos de alta calidad	
Tejidos	Lana y cuero	
Combustible	Madera y leña	
Alimento de agricultura	Vino, aceite, cereales, ajos, etc.	
Acervo genético	Razas autóctonas, aves esteparias	

Anexo B.2

Beneficios que el ser humano obtiene de la naturaleza de manera indirecta a través de la REGULACIÓN de procesos		
Beneficio	***Ejemplo***	***Foto***
Regeneración de especies vegetales	Rebrote de encinas y pinos, hongos, calidad del pasto	
Control de especies	Eliminación de malas hierbas	
Aire limpio	"corredor verde"	
Hábitat para especies	Refugio y guardería de especies, conectividad ecológica	
Prevención de incendios	Por el desbroce de los animales	
Control de la erosión	Cobertura de vegetación que retiene suelo en las raíces	
Dispersión de semillas	Animales que ayudan a dispersar frutos, semillas y esporas	
Fertilización del suelo	Fertilización del suelo con los desechos animales	
Polinización	Insectos polinizadores	
Regulación del microclima	Papel de la vegetación en el secuestro de CO_2 y en la lluvia	
Regulación hídrica	Evapotranspiración de la vegetación	
Mantenimiento de cunetas	En caminos y carreteras	

Anexo B.3

Beneficios que el ser humano obtiene de la naturaleza de manera intangible relacionados con aspectos CULTURALES		
Beneficio	***Ejemplo***	***Foto***
Tranquilidad, relajación	Paseos a la sombra	
Turismo activo en la naturaleza	Senderismo, equitación, ciclismo	
Identidad cultural	Cultura pastoril, mezda de culturas	
Caza recreativa	Caza menor (perdiz, liebre, conejo), caza mayor (gamos, corzo, jabalí)	
Conocimiento científico	Investigaciones en ecología, etnografía, historia	
Educación ambiental	Educación ambiental, libros sobre trashumanda	
Espectáculos taurinos	Encierros, corridas, novilladas...	
Paisajes	VP: elemento diversificador, escenas bonitas→ fotografía, documentales	
Vía de comunicación	Cañada →Entre fincas/pueblos, para personas y animales	
Valores espirituales	Satisfacción de que exista la ganadería trashumante	
Conocimiento tradicional	Manejo de los animales, salir a ver el paso del ganado por el municipio	
Turismo rural	Cortijos, gastronomía, agroturismo	

Anexo C

Modelo de cuestionario aplicado en el caso de estudio de la Cañada Real Conquense para la valoración socio-cultural de los servicios mediante estímulos visuales (capítulo 4.4).

Laboratorio de Socio-Ecosistemas

UNIVERSIDAD AUTONOMA DE MADRID

EVALUACIÓN DE LA CALIDAD DEL PAISAJE CULTURAL MEDITERRÁNEO Y SU REALACIÓN CON LOS BENEFICIOS QUE REPORTAN LOS ECOSISTEMAS

En la Universidad Autónoma de Madrid trabajamos desde hace tiempo los vínculos entre los seres humanos y la naturaleza. En este momento tratamos de identificar y analizar los beneficios proporcionados por diversos paisajes culturales de la España mediterránea del interior. Nos sería de gran ayuda conocer su opinión a través de esta encuesta. ¿Sería tan amable de contestarla? ¡Muchas gracias!

FECHA .... Nº DE ENCUESTA .... LOCALIZACIÓN ....

TEST DE PARES DE IMÁGENES FOTOGRÁFICAS DE PAISAJES CULTURALES

A continuación le mostramos un conjunto de pares de imágenes de paisajes culturales mediterráneos. ¿Sería tan amable de elegir la imagen que prefiera de las dos que integran cada par? Guíese por su propio criterio.

	IZDA	*DCHA*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

	IZDA	*DCHA*
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

	IZDA	*DCHA*
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

PANEL DE IMÁGENES DE PAISAJES

¿Sería capaz de ordenar viente imágenes según su preferencia personal? El método a seguir será el siguiente: escoja las cuatro que más le gusten. A continuación haga lo mismo con las cuatro que prefiera de entre las restantes, y así dos veces más hasta dejar las cuatro que menos le gusten.

1. ¿Qué motivos le hicieron elegir las imágenes más preferidas en el panel?

2. ¿Qué motivos le hicieron seleccionar las imágenes menos preferidas o rechazadas?

Percepción visual de paisajes mediterráneos y los servicios reportados por los ecosistemas que los integran.

Les hemos mostrado paisajes de la Sierra de Albarracín (Teruel), de la Serranía de Cuenca, del mosaico agrario de Castilla-La Mancha con predominio de cultivo de vid, girasol, olivo y cereal y algunas dehesas de encinas en la zona oriental de la Sierra Morena (Jaén). La naturaleza en estos paisajes reporta de manera directa o indirecta beneficios para la subsistencia y el bienestar humanos, por ejemplo: a través de los árboles obtenemos la madera necesaria para la construcción de mobiliario; algunas plantas fijan el suelo y los taludes; otras especies juegan un papel estético y que embellece el paisaje, etc.

1. A continuación le mostramos algunas de las imágenes que ha evaluado. Según su experiencia personal. ¿Qué grado de beneficio considera que los paisajes que le mostramos a continuación proporcionan al ser humano, para cada servicio especificado en la columna central?

Foto izda. PAR A					**Foto dcha. PAR A**			
1. Nada	2. Algo	3. Bastante	4. Mucho	**SERVICIOS ECOSISTEMAS**	1. Nada	2. Algo	3. Bastante	4. Mucho
				Alimento ganadería				
				Alimento agricultura				
				Pastos y forrajes				
				Recolección				
				Madera				
				Prevención incendios				
				Control erosión				
				Hábitat para especies				
				Aire limpio/fresco				
				Regeneración vegetal				
				Conectividad				
				Belleza/paisaje				
				Identidad cultural				
				Turismo y recreación				
				Caza				
				Tranquilidad/relajación				
				Otros				

Foto izda. PAR B					Foto dcha. PAR B			
1. Nada	2. Algo	3. Bastante	4. Mucho	**SERVICIOS ECOSISTEMAS**	1. Nada	2. Algo	3. Bastante	4. Mucho
				Alimento ganadería				
				Alimento agricultura				
				Pastos y forrajes				
				Recolección				
				Madera				
				Prevención incendios				
				Control erosión				
				Hábitat para especies				
				Aire limpio/fresco				
				Regeneración vegetal				
				Conectividad				
				Belleza/paisaje				
				Identidad cultural				
				Turismo y recreación				
				Caza				
				Tranquilidad/relajación				
				Otros				

2. A continuación le mostramos un panel de cuatro imágenes sobre el que le pedimos que evalúe el grado de beneficio que considera que proporcionan al ser humano, respecto a los servicios especificados en la columna de la izquierda. Puntúe de 1 a 4

SERVICIOS ECOSISTEMAS	FOTO A	FOTO B	FOTO C	FOTO D
Alimento ganadería				
Alimento agricultura				
Pastos y forrajes				
Recolección				
Madera				
Prevención incendios				
Control erosión				
Hábitat para especies				
Aire limpio/fresco				
Regeneración vegetal				
Conectividad				
Belleza/paisaje				
Identidad cultural				
Turismo y recreación				
Caza				
Tranquilidad/relajación				
Otros				

Identidad cultural/Conocimiento de la trashumancia y la Cañada Real Conquense

1. Lugar de residencia habitual: ....
2. ¿Desde cuándo vive usted aquí/allí? .... años.
3. Su infancia la vivió en ...., zona Rural ☐ o Urbana .☐
4. Sus padres/abuelos eran de zonas de tipo rural ☐ urbano☐
5. ¿Usted se siente más Rural☐ o Urbano ☐ ? (sentimiento personal).
6. ¿Visita con frecuencia localidades de la España mediterránea de interior similares a las que le hemos mostrado en fotografías? Citar ejemplos y decir frecuencia.
7. Qué actividades realiza en ellas.
8. Sabe lo que es la trashumancia? SI☐ NO☐ En caso afirmativo díganos su definición.
9. ¿Conoce personalmente algún paisaje vinculado con la trashumancia? (cañadas/pastos). Citar localidades o comarcas.
10. Ha reconocido en las fotografías que le hemos mostrado algún paisaje relacionado con la trashumancia o la ganadería extensiva tradicional.
11. ¿Conocía o conoce algún ganadero trashumante? ¿Quiénes?
12. ¿Ha tenido algún contacto o experiéncia personal en su vida, vinculada a la trashumancia?

Variables de comportamiento ambiental

1. ¿Es usted miembro de alguna asociación con fines ambientalistas? ¿Cuál?
2. ¿Ha visitado Vd. algún/os espacio/s natural/es los últimos dos años? .Cite algunos.
3. ¿lee revistas u otras publicaciones de tipo ambiental? ¿con qué frecuencia?
4. ¿compra o consume alimentos producidos de agricultura ecológica y/o comercio justo? ¿frecuencia?

Variables socio-económicas

1. Edad ..... años Sexo: Hombre ☐ Mujer ☐

2. ¿Podría decirme cuál es su nivel de estudios?

   ☐ Primarios ☐ Secundaria / Bachillerato ☐ Universitarios ☐ Ninguno

3. ¿Tiene alguna formación relacionada con las ciencias de la naturaleza? ¿cuál?

4. ¿Cuál es su profesión? ………………………………………………………………………………………..….

5. ¿Está usted relacionado de alguna manera con ganadería/agricultura etc)? Especificar vínculo

6. ¿Dentro de qué intervalo se incluyen sus ingresos mensuales individuales netos?

   - ☐ < de 700 € (<116.200 pts)
   - ☐ 700 – 1.400 € (116.200-232.400pts)
   - ☐ 1.401 – 2.100 € (232.401- 348.600 pts)
   - ☐ 2.101 – 2.800 € (348.601-464.800 pts)
   - ☐ 2.801 – 3.200 € (464.801-531.200 pts)
   - ☐ > de 3.200 € (> 531.200 pts)

Sugerencias o comentarios

……

……

……

……

A rellenar por el encuestador:

• Lugar de la encuesta: ……………………………………………………………

• Actitud del encuestado: buena / indiferente / poco dispuesto

• Entendimiento del cuestionario: alto / medio / bajo

Anexo D

Fotografías empleadas durante la aplicación del cuestionario del ANEXO C (capítulo 4.4).

Anexo E

Modelo de cuestionario aplicado en el caso de estudio de la Cañada Real Conquense para la evaluación del conocimiento ecológico tradicional vinculado a la trashumancia (capítulo 4.6).

Lugar de encuesta		*Número encuesta*		
Encuestador/a		*Fecha*		
Cuestionario socio-demográfico. **Preguntas sobre la persona entrevistada**				
	¿Cuál es tu pueblo?			
		PIE	CAMIÓN	TREN
	A lo largo de tu vida, ¿cuántos años has trashumado?			
	¿Sigues trashumando? ¿Cómo?			
	¿A qué zona(s) del sur vas /ibas?			
	¿Cuándo fue la última vez que trashumaste?			
	¿Tu padre trashumaba? ¿Cómo?			
	¿Alguno de tus abuelos trashumó? ¿Cómo?			

A rellenar por el/la encuestador/a:

- Lugar de la encuesta: ....
- Actitud del encuestado: buena / indiferente / poco dispuesto
- Entendimiento del cuestionario: alto / medio / bajo
- Evaluación subjetiva del LEK del encuestado: escaso/regular/bueno/excelente
- Sexo del encuestado: hombre / mujer

<table>
<tr><th>Pregunta</th><th>Respuestas</th></tr>
<tr><td>1. En un rebaño mayoritariamente de ovejas ¿es importante tener cabras? ¿por qué?</td><td>o Pueden funcionar como madres eventuales de los corderos.
o Los machos cabríos ayudan a guiar el rebaño (son los primeros en moverse)
o Abren camino (“rompen”) cuando hay que pasar por un estrechamiento.
o Hacen un aprovechamiento complementario del campo (evitan que el monte se cierre,….).
o Dan leche.
o Dan chotos.
Otras:…………….</td></tr>
<tr><td>2. En un rebaño de ovejas ¿cuál es el número ideal de machos por cada 100 hembras (para maximizar la productividad)?</td><td>2-4 machos</td></tr>
<tr><td>3. ¿Cuál sería el tamaño máximo de un rebaño de ovejas para que lo puedan llevar cómodamente dos pastores con perros y sin caballo durante la vereda (más el que lleva el hato)?</td><td>Anotar el número
(Alrededor de 1200)</td></tr>
<tr><td>4. Cuándo sólo había una paridera ¿en qué época se echaban los carneros? ¿por qué en esa época?</td><td>A finales de junio (por San Pedro, 29 de junio o San Juan, 24 de Junio).</td></tr>
<tr><td>5. ¿Cuántos kilos de lana hace una oveja merina al año?</td><td>Hace entre 2 y 2,5 kg /año (¿?).</td></tr>
<tr><td>6. ¿Conoces algún truco para que una madre adopte a un cordero que no es suyo, cuando el suyo se ha muerto? ¿Cuándo fue la última vez que lo usaste? (anotar fecha: “hace…”)</td><td>- Coger uno de los que ha nacido y lo restriegas sobre el que ha muerto.
- Ponerle un “pijama” o pellejo del que ha muerto.
- Atarlos juntos por las patas.
- Castigo (goma, echarle el perro, echarle el gato).
- Sal con vinagre en la vagina y restregar al cordero.
- Cortar el rabo a los dos, enganchar el del muerto al vivo.</td></tr>
<tr><td>7. ¿Cómo se denominan las ovejas según sus dientes?</td><td>- Corderos o borregos, diente de leche.
- Primalas, las dos primeras paletas.
- Andoscas, las cuatro.
- Trasandoscas (tera-, tranan-, retan-), seis.
- Cerrás, todos los dientes.</td></tr>
<tr><td>8. ¿Podrías reconocer en esta figura cuatro tipos de marcas para las orejas de las ovejas? (se enseña panel con dibujos)</td><td>Otros: abuzá…<table><tr><td>muesga</td><td>esguarre (=esgarre)</td><td>urquilla (=horquilla)</td><td>hojahiguera,</td></tr><tr><td>cercillo</td><td>esfonte (=espunte)</td><td>cubripan (=puerta)</td><td>sacabocado</td></tr></table></td></tr>
</table>

Pregunta	Respuestas
9. Antes se marcaban a los animales con la pez. ¿Sabes qué materiales se necesitan para prepararla? (Si lo sabe) ¿cómo se hacía?	Madera con resina de pino/ teda. Palabras clave del "cómo": quemar, cocer, olla de piedra, peguera, agujero…
10. Además de la oreja y la empega, ¿Cómo se marcaban antiguamente las ovejas para evitar los robos? *¿Cuándo fue la última vez que lo hiciste?*	Con un hierro en el morro.
11. ¿Podrías nombrar cinco tipos de cencerros y ordenarlos del más grande al más pequeño?	Arrancaira, Esquila, Cañón, Arriera encañoná, Arriera, Truco, Picote, Picota, Picoteja, Cencerra, Tanganillo, Campanilla y Cascabeles. Otros:……………..
12. Ahora, cuando no hay pasto/comida para los animales, se les da pienso. Antiguamente ¿qué se hacía? [hace más de 50 años]	- se primaba a la madre sobre la cría, dejando morir a esta última (porque la lana era más valiosa). - en la vereda se pagaba a los guardas/agricultores para que les dejaran meterse un poco en los cultivos o los rastrojos. - Buscar pastos en otros lugares. - Pasar hambre.
13. ¿Puedes mencionar dos plantas buenas como pastos de la zona de agostada y dos de la invernada?	Agostada: pipirigallo, flor del sebo, carretón, arveja. Invernada: carretón (=trébol), saeta (hierba de la pincha), lechugueta (chicoria), chupamiel.
14. En la zona de invernada, ¿cuándo es buena y cuándo es mala la "saeta"?	En Andalucía la Saeta es muy buena en invierno como pasto, pero según se va acercando el verano (cuando se seca) se pega al ganado y les pincha (puede producir heridas tanto en humanos como en el ganado). Es mala cuando tiene espiga (abril-junio). Tras caerse la espiga vuelve a ser buena, sobre todo para las vacas.
15. ¿En qué consiste la práctica del redileo (arrilar)? ¿Por qué es bueno hacerlo? ¿Por qué sale mejor pasto? *¿Cuándo fue la última vez que lo hiciste?*	- Ir moviendo el redil donde duerme el ganado cada 3-4 días. - Sirve para ir abonando y conseguir mejores pastos el año siguiente. - Además de abonar, con el pisoteo fijan las semillas.
16. Antes, cuando necesitaban cerrar el ganado ¿De qué se hacían los corrales? ¿Cómo han ido cambiando? ¿Por qué? / *¿Has usado el pastor eléctrico? (esta última no puntúa)*	- Antes se hacían de esparto (red), más o menos hasta 1960 - luego de malla metálica y alcancillas - ahora se usa el pastor eléctrico.

Pregunta	Respuestas
17. ¿Cómo debe comportarse un mastín durante el día? ¿Y de noche frente a un ataque de lobo?	- Va tranquilo caminando entre las ovejas al mismo ritmo. Siempre manteniéndose pegados al rebaño. "Trabajan" de noche protegiendo al ganado. - Ante lobos, debe ladrar - y hacer ataques cortos y regresar al redil para proteger al rebaño (no salir persiguiendo al lobo).
18. Cuando las ovejas comen mucho, y están nerviosas, inquietas; ¿Qué barruntan?	Cambio de tiempo a peor (que va a nevar o viene mal tiempo)
19. Cuando salen los sapos grandes (*sapazos escupidores)* ¿Qué indican? ¿Sabes algún otro animal que indique cambio de tiempo?	- Indica que va a llover (aumentar la humedad) - Las hormigas voladoras. Otros: …
20. Completa el refrán: "Lluvia en Enero… ¿Cómo sería un muy buen año de lluvias / climatológico para el pasto y el ganado trashumante?	- …cuchillo para el cordero…"(los mata) - "Hay otoño en Andalucía" si llueve desde finales de septiembre y en Octubre. - En invierno poca lluvia, en febrero y marzo que empiece a llover más. - En primavera que alterne sol y lluvia.
21. ¿Por qué les da basquilla a las ovejas? ¿Conoces algún remedio o práctica natural para tratarla o evitarla? *¿Cuándo fue la última vez que lo usaste? ¿Ahora qué se usa?*	El cambio brusco de alimentación potenciado por el stress o hacinamiento. - Cambiarlas a un pasto peor. - Sangrado. → Ahora: vacuna
22. ¿Conoces algún remedio natural para la roña (sarna)? ¿Lo has usado alguna vez? *¿Cuándo fue la última vez que lo usaste?* *¿Cómo conseguías estos productos?* *¿Ahora qué se hace?*	El aceite de enebro (miera) o el aceite de culebra. (Ahora se utiliza zotal rebajado pero si responde esto → preguntar por antes del zotal) Otros:…
23. ¿Conoces algún remedio natural para la cagada de la mosca (gusano) *¿Cuándo fue la última vez que lo usaste?* *¿Ahora qué se hace?*	- Cruzar dos ramitas de cardo con una piedra apoyada sujetándolas en el centro en el lugar en el que ha pisado el animal enfermo con la pata trasera izquierda. Cuando se seca el cardo, se "cae la mosca". - También tirar bola de torvisco a las vacas. - Otro remedio era la savia de la lichiterna. Otros:…
24. ¿Conoces algún remedio natural para la las nubes de los ojos (como las cataratas)? *¿Cuándo fue la última vez que lo usaste?* *¿Ahora qué se hace?*	- Soplando sal en el ojo enfermo. - Impregnando la zona con sangre de la oreja del propio animal. - Clavando una estaquilla (generalmente de triguera) en la nariz/encía (llegando hasta el lagrimal) de las ovejas. - Coger el velo con un alfiler/imperdible, tirar de él y cortar. Otros:….

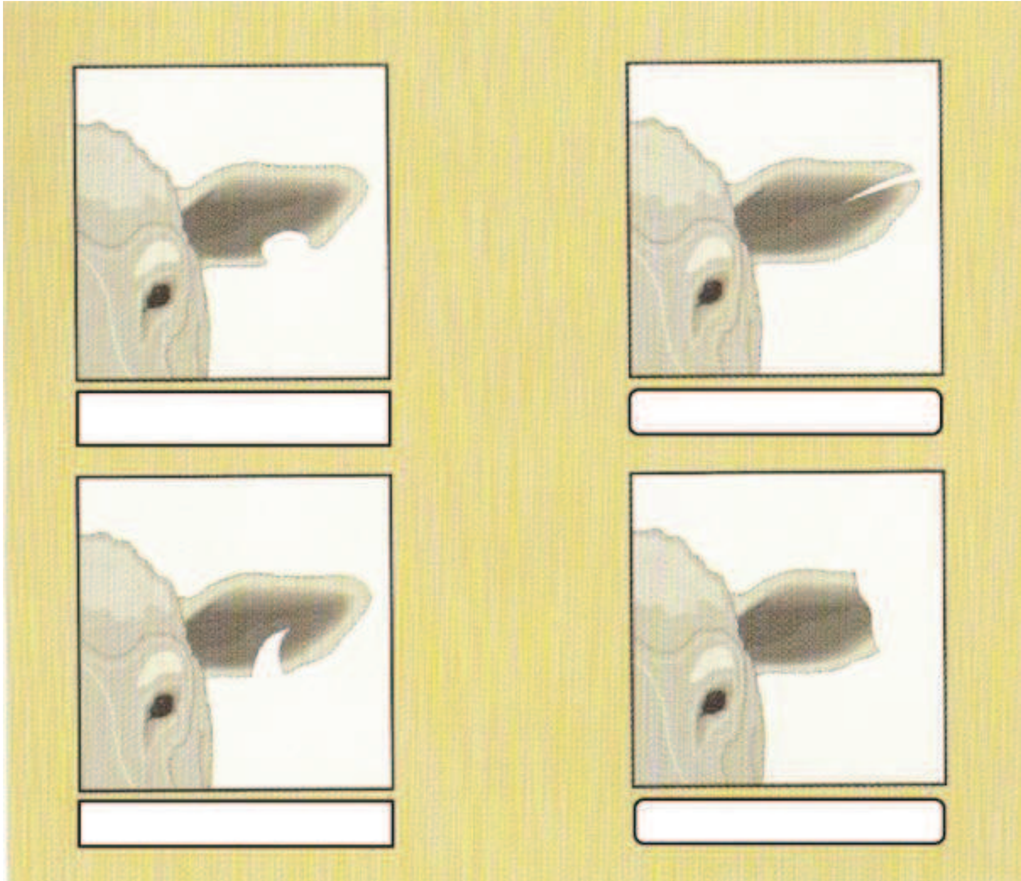
Pregunta	**Respuestas**
25. ¿Cuándo se tardaba más en hacer la vereda, antes de los trenes o ahora? [Si ha sabido la anterior →¿Por qué ha sucedido este cambio?]	Se tarda más ahora. Antes: había muchos rebaños y poca comida, además el camino era más incómodo, querían llegar antes; Ahora: los animales encuentran más comida y se detienen más a comer.
26. En este mapa ¿podrías dibujar el recorrido de la CRC? ¿Puedes mencionar cinco municipios/pueblos de La-Mancha por los que pasa la Cañada Conquense?	Dibujar en el mapa. Anotar municipio mencionados (máximo 5). Vale cualquier respuesta correcta.
27. Si tuvieras que hacer la vereda a pie el año que viene ¿qué cultivos deberías guardar? ¿A qué otros problemas te enfrentarías?	Cultivos: - Girasol / viñedo / cereales Problemas: - falta de agua - carreteras y vías de tren - núcleos urbanos - estrechamientos - basuras/escombros - canteras
28. ¿En qué municipios/pueblos de La-Mancha (por los que pasa la CRC) hay más problemas de disponibilidad de agua? (apretar para que precisen)	Generalmente los peores son los de la concentración parcelaria (desde La Almarcha hasta el Río Júcar).
29. ¿Cuál es la fecha tradicional del raboteo? *¿Por qué?*	Primer viernes de marzo. No se recuerda el por qué (a ver si algún encuestado/a conoce el por qué)
30. ¿Qué se hacía tradicionalmente por San Miguel, el 29 de septiembre? ¿Por qué en esa fecha?	El ajuste de pastores: se renovaban o cambiaban los contratos entre los pastores y los propietarios del ganado.
31. ¿Qué es y de qué está hecho el *zagón*? ¿Qué es y de qué está hecho el *zaque*?	El zagón es una prenda de vestir, como un pantalón con peto, hecha de piel de oveja con lana. El zaque es un recipiente pequeño, generalmente de cuero de cabra, cosido y empegado por todas partes menos por la del cuello del animal
32. ¿Sabrías qué es el *somarro*? ¿Y cómo se hace? *¿Cuándo fue la última vez que lo hiciste (en tu casa)?*	Se mata la oveja, se tiene 2 días que se seque la carne, luego se abre el espinazo por un lado y otro y se quitan las costillas por la parte del peto, la delante. La paletilla <u>se abre y se deshuesa</u>, la pierna se le quita el hueso y se le deja la taba de atrás para colgarlo. Luego se cuelga bien tendido para que se seque bien. El adobo es bastantes ajos, vinagre y sal, y se tiene un par de días en <u>adobo y luego ya se cuelga para secar</u>. Una vez que esté seco lo puedes freír un poco o asarlo un poquito.
33. ¿Puedes completar este refrán: "Muy buena es la umbría.....? ¿Qué significa este refrán?	...pero mis ovejas solana pedían (...pero solana mía). La hierba de umbría aguanta más (pero es más agría); es de mucho mejor la calidad el pasto de solana.
34. ¿Cuáles son los 5 mandamientos del pastor?	Primero, guisar los gazpachos en el caldero. Segundo, dejar las ovejas por todo el mundo. Tercero, matar el mejor cordero. Cuarto, ir con el burro a por el hato. Quinto, no decir la verdad ni a Jesucristo

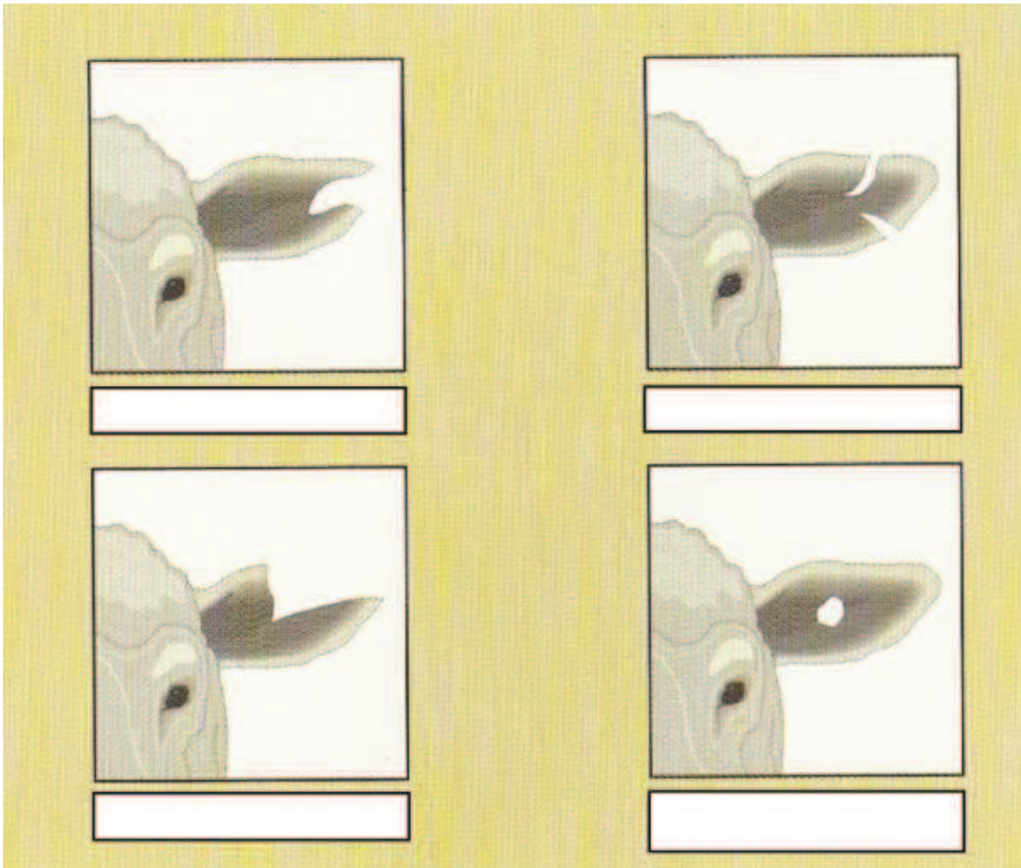
Pregunta	**Respuestas**
35. ¿Conoces algún refrán relacionado con el ganado? (SI SABE VARIOS, TIRAR DE LA LENGUA)	Respuesta libre.

<table>
<tr><td>Nombre y apellidos</td><td colspan="4"></td></tr>
<tr><td>Edad</td><td colspan="4"></td></tr>
<tr><td>Lugar nacimiento:</td><td colspan="4"></td></tr>
<tr><td>Profesión principal ejercida en su vida (Anotar)</td><td colspan="4"></td></tr>
<tr><td>Profesión secundaria ejercida en su vida</td><td colspan="4"></td></tr>
<tr><td>Profesión principal del padre</td><td colspan="4"></td></tr>
<tr><td>Profesión secundaria del padre</td><td colspan="4"></td></tr>
<tr><td>¿Hasta qué curso/años estudiaste?</td><td colspan="4">Anotar el curso/año</td></tr>
<tr><td rowspan="3">¿Quién te enseñó principalmente lo que sabes sobre trashumancia/manejo del ganado? Ordena los tres principales por importancia (1-3)</td><td>Padre</td><td>Madre</td><td>Abuelo</td><td>Abuela</td></tr>
<tr><td>Hermano</td><td>Hermana</td><td>Tío</td><td>Tía</td></tr>
<tr><td>Otros fam.</td><td>Otros past.</td><td>Yo solo/a</td><td>Otrxs…</td></tr>
<tr><td>¿Con quién trashumas/trashumabas?</td><td colspan="4"></td></tr>
</table>

Anexo F

Imagen de los tipos de señales de orejas que se realizan en las ovejas empleada durante la aplicación del cuestionario del ANEXO E.





Anexo G

Otras publicaciones.

Anexo G. Otras publicaciones

Martín-López B, Iniesta-Arandia I, García-Llorente M, Palomo I, Casado-Arzuaga I, Del Amo DDG, Gómez-Baggethun E, **Oteros-Rozas E**, Palacios-Agundez I, Willaarts B, González JA, Santos-Martín F, Onaindia M, López-Santiago C, Montes C (2012). *Uncovering Ecosystem Service Bundles through Social Preferences*. PLoS ONE 7(6): e38970.

Abstract

Ecosystem service assessment has been increasingly used to support environmental management policies mainly based on biophysical and economic indicators. However, few studies have coped with the social-cultural dimension of ecosystem services despite it has been considered a research priority. We examined how ecosystem services bundles and trade-offs can be emerged from diverging social preferences towards ecosystem services delivered by different types of ecosystems in Spain. We conducted 3379 direct face-to-face questionnaires in eight different case study sites from 2007 to 2011. Overall, 90.5% of sampled population recognized the ecosystem's capacity to deliver services. Formal studies, environmental behaviour, and gender variables influenced the probability of people recognizing the ecosystem's capacity to provide services. Regulating services were those mostly perceived by people, placing the greatest importance on air purification. However, statistical analysis showed that socio-cultural factors and the conservation management strategy of ecosystems (i.e., National Park, Natural Park, or non-protected area) have an effect on social preferences towards ecosystem services. Ecosystem services trade-offs and bundles were identified by analyzing social preferences through multivariate analysis (redundancy analysis and hierarchical cluster analysis). We found a clear trade-off between provisioning (and recreational hunting) versus regulating and almost all cultural services. We identified three ecosystem services bundles, associated to the rural and urban dichotomy and the conservation management strategy. We conclude that socio-cultural preferences towards ecosystem services can serve as a tool to identify relevant services for people, the factors underlying these social preferences, and the emerging ecosystem services bundles and trade-offs.

Carmona, C.P., Azcárate F.M., **Oteros-Rozas E.,** González J.A., Peco B. 2013. *Assessing the effects of seasonal grazing on holm oak regeneration: implications for the conservation of Mediterranean dehesas*. Biological Conservation 159: 240–247.

Abstract

Scattered trees in agricultural landscapes are globally declining due to the intensification of agricultural practices. Dehesas, highly species-diverse Mediterranean open woodlands, are seriously affected by this decline, because of a generalized regeneration failure of oak, which compromise their long-term stability. Traditionally, dehesas were the wintering areas for transhumant herds, but transhumance is disappearing in the Mediterranean, due to multiple causes. Reductions in grazing intensity or grazing abandonment have been proposed to improve oak regeneration in dehesas, but the effect of the recovery of non- continuous grazing practices such as transhumance has not been tested to date. We measured different indicators of holm oak regeneration and condition in dehesas under transhumant grazing and in dehesas under permanent grazing in southern Spain. Oak juveniles were remarkably less browsed and their can- opies covered a much higher area in transhumant estates. As a consequence, the median density of sap- lings was more than four times higher in transhumant than in permanently-grazed estates. Although transhumant grazing is necessarily associated with a reduction in the stocking rate across the year, the timing of grazing was always included as a predictor in the best models to explain the condition and den- sity of holm oak. Our results suggest that the lack of oak regeneration in dehesas can be caused not only by the increases in stocking rates, but also by the recent abandonment of traditional grazing practices like transhumance. We propose the recovery of seasonal grazing regimes based on transhumant pastoralism as a measure to improve the conservation status of dehesas.

Plieninger, T., Dijks S., **Oteros-Rozas, E.,** Bieling, C. 2013. *Assessing, mapping and quantifying cultural ecosystem services at community level*. Land Use Policy, 33: 118-129.

Abstract

Numerous studies underline the importance of immaterial benefits provided by ecosystems and espe- cially by cultural landscapes, which are shaped by intimate human–nature interactions. However, due to methodological challenges, cultural ecosystem services are rarely fully considered in ecosystem ser- vices assessments. This study performs a spatially explicit participatory mapping of the complete range of cultural ecosystem services and several disservices perceived by people living in a cultural land- scape in Eastern Germany. The results stem from a combination of mapping exercises and structured interviews with 93 persons that were analyzed with statistical and GIS-based techniques. The results show that respondents relate diverse cultural services and multiple local-level sites to their individual well-being. Most importantly, aesthetic values, social relations and educational values were reported. Underlining the holistic nature of cultural ecosystem services, the results reveal bundles of services as well as particular patterns in the perception of these bundles for respondent groups with different socio-demographic backgrounds. Cultural services are not scattered randomly across a landscape, but rather follow specific patterns in terms of the intensity, richness and diversity of their provision. Result- ing hotspots and coldspots of ecosystem services provision are related to landscape features and land cover forms. We conclude that, despite remaining methodological challenges, cultural services mapping assessments should be pushed ahead as indispensable elements in the management and protection of cultural landscapes. Spatially explicit information on cultural ecosystem services that incorporates the differentiated perceptions of local populations provides a rich basis for the development of sustainable land management strategies. These could realign the agendas of biodiversity conservation and cultural heritage preservation, thereby fostering multifunctionality.

Vilardy, S., González, J.A., Martín-López, B., **Oteros-Rozas, E.**, Montes C., 2012. *Los servicios de los ecosistemas de la Reserva de Biosfera Ciénaga Grande de Santa Marta.* Revista Iberoamericana de Economía Ecológica. 19: 66-83.

Abstract

The Biosphere Reserve Ciénaga Grande of Santa Marta (RBCGSM) is a complex coastal and marine wetland system with a strong functioning interdependency. These ecosystems interact with several local communities through the supply of ecosystem services. The aim of this paper was to identify ecosystem services of RBCGSM that are perceived by different actors. We carried out semi-structured interviews in order to analyze the social perception, the trends of changes and a social valuation of ecosystem services. We obtained 777 responses which were typified in 34 categories, from which 55% were provisioning services, 43% cultural services, and 2% were regulating services. The supply of approximately half of them has decreased (43,9%) or disappeared (4,6%) and three-quarters of perceived services were considered as essential (46,8%) or very important (28,5%) for interviewees. The results provide a base of knowledge required for the analysis of the implications of ecosystem services use, as well as for the proposal and implementation of management guidelines aimed at maintaining a sustainable flow of ecosystem services essential for human wellbeing.

Hevia, V., Azcárate, F.M., **Oteros-Rozas, E.,** A., González, J. *Exploring the role of transhumance drove roads on the conservation of ant diversity in Mediterranean agroecosystems.* En revisión en Biodiveristy and Conservation.

Abstract

Drove roads are an essential component of transhumance, and are a major feature in Mediterranean countries where this livestock management system has been in practice for centuries. In Spain, due to a gradual decline in transhumant practices, many drove roads have been completely or partially abandoned by herds, being transformed to other land uses. Yet some major drove roads are still used for the passage of livestock, and might exert important effects on the conservation of biodiversity and ecosystem functions, particularly in highly transformed agricultural landscapes. In this study, we compare ant taxonomic and functional diversity on a drove road still used by transhumant livestock (the Conquense Drove Road) versus an abandoned one (the Murciana Drove Road). Ant species richness per trap and total richness were significantly higher on the drove road in use compared to the abandoned one. The presence of the drove road with livestock use also had a positive effect on ant species diversity in adjacent croplands (both herbaceous crops and vineyards). Ant functional diversity was also higher on the drove road in use. These results highlight the important role of drove roads as ecologically unique systems and reservoirs of biodiversity in intensive agricultural landscapes; however, these effects are largely dependent on the maintenance of livestock use.

Hernández-Morcillo, M., Hoberg, J., **Oteros-Rozas, E.**, Plieninger, T., Gómez-Baggethun, E., Reyes-García, V. *Traditional Ecological Knowledge in Europe: Status Quo and Insights for the Environmental Policy Agenda.* En revisión en Environment: Science and Policy for Sustainable Development.

Abstract

Traditional Ecological Knowledge (TEK) is recognized as locally adapted expressions of natural resource management. Promoted for its potential role in ecosystem management, TEK has received increasing attention in the political arena, as evidenced by its increasing consideration in the Convention on Biological Diversity (CBD) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). However, although a multitude of studies have addressed TEK in developing countries, TEK research is still scant in developed-country settings. Until now, no comprehensive review on European TEK has been available. In this paper, we provide an overview of the state of the art of TEK research in Europe by reviewing the existing scholarly literature and analysing its main features and knowledge gaps. Our review illustrates that research about remaining bodies of TEK in Europe is fragmented, allowing for limited comparability due to a lack of common and consistent definitions adjusted to the European context. Research on TEK in Europe has focused on remote peripheral regions and emblematic socio-cultural groups, suggesting an alarming TEK loss rate. Overall, research results shows that TEK can increase the capacity of European social-ecological systems to respond to environmental changes. We conclude that a strategic effort is needed to coherently approach TEK within the European context for improving mainstreaming into environmental policy processes such as IPBES.

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